

Thomas C. Richardson
Project Manager
Environmental Assets & Initiatives

6400 Poplar Avenue
Memphis, TN 38197

T 901 419 3878
F 901 419 3962
Tom.Richardson@ipaper.com

November 7, 2005

Mr. Narindar Kumar, Chief
Mr. Russ McLean, Project Manager
RCRA Programs Branch
Waste Management Division
United States Environmental Protection Agency Region 4
61 Forsyth Street
Atlanta, GA 30303-8960

Subject: Preliminary Corrective Measures Study Report
International Paper Treated Wood Products Plant
Wiggins, Mississippi
EPA ID No. MSD 980 600 084

Dear Mr. Kumar and Mr. McLean:

Enclosed are three copies of the Resource Conservation and Recovery Act (RCRA) Preliminary Corrective Measures Study (CMS) Report for the International Paper Treated Wood Products Plant in Wiggins, Mississippi (Wiggins facility). The Preliminary CMS was conducted in accordance with the U.S. Environmental Protection Agency (EPA) approved CMS Work Plan (Premier, 2004), and the conditions listed in Part II.G of the Hazardous and Solid Waste Amendment (HSWA) permit modification for the Wiggins facility (EPA I.D. MSD 980 600 084). The enclosed report was prepared in general accordance with Part II.G.3 of that same permit.

The purpose of conducting this Preliminary CMS was to identify potential remedies for completion of corrective measures at several Areas of Concern (AOCs) and Solid Waste Management Units (SWMUs) located at the Wiggins Facility. This Preliminary CMS Report specifically addresses potential corrective measures for four areas located within the Wiggins facility:

- Treatment Area 1 (SWMUs 21 through 25, 38, and 39)
- Treatment Area 2 (SWMUs 26 through 29, 32, and 33)
- Site drainage ditches (SWMU 37)
- Church House Branch (AOC B)

In communications between EPA and International Paper, it was agreed that corrective measures for Treatment areas 1 and 2 would consist of institutional controls and continued operation of the Wiggins facility for industrial purposes (e.g. continued use for wood-treating operations). As such, the CMS Work Plan focused on activities involving

the collection of additional data to address data gaps identified by EPA during its review of the RFI Report, as well as data gaps identified in the screening-level ecological risk assessment conducted as part of the RFI. These additional data were collected from the site drainage ditches that are located in and drain to the forested area between the Wiggins facility's operational area and Church House Branch. Further, the CMS Work Plan outlined the approach to collect data in order to:

- Assess the general water and sediment quality of Church House Branch upstream, within, and downstream of the Wiggins facility; and
- Aid in determining the need for corrective measures in Church House Branch.

In general, the findings of the evaluation of water and sediment quality of Church House Branch indicate a number of Wiggins facility-related chemicals (e.g. polycyclic aromatic hydrocarbons and pentachlorophenol) exceeded their respective selected ecological screening values. In addition, a number of constituents of interest upstream of facility operations were found to be constituents of potential ecological concern (CoPECs) through a screening process. These contaminants include three metals (cadmium, silver, zinc), two SVOCs [benzyl alcohol, bis(2-ethylhexyl) phthalate], two VOCs (chloroform, toluene), one chlorinated pesticide [2,4,5-TP (Silvex)] and cyanide. Most, if not all, of these CoPECs observed upstream of the Wiggins facility are highly toxic to aquatic life as discussed in the CMS Report; hence, the contaminant concentrations may have deleterious effects to both aquatic and terrestrial invertebrates and vertebrates. The sources of contamination to Church House Branch are likely many and varied, as the areas surrounding the stream, both upstream and downstream of the Wiggins facility, range from residential to industrial land use, all of which are potential point and non-point sources of contamination. Contributors to surface water contamination appear to be upstream of the facility, and are likely associated with the City of Wiggins sewage discharges, as evident in the CMS sampling efforts and discussed in the CMS Report. It is likely that a significant risk to aquatic wildlife stems from the metals and organic compound contamination that appears to be associated with City of Wiggins and surrounding land use.

The CMS Report provides arguments for Natural Remediation (NR) as a corrective action for sediments and surface soils affected with site-related chemicals. Based on these arguments and on the recognition that non-facility-associated contaminants in Church House Branch may pose equal or greater risk to ecological receptors of concern than contamination due to facility-associated historical spills, and that site-related contaminants detected in sediments do not appear to desorb to the surface water column, International Paper recommends "No Further Action" be taken, and that both soils and sediments be allowed to naturally remediate. The uncertainties inherent in suggesting the NR alternative at this early stage of the ecological risk assessment (ERA) process are: 1) immediacy of risk to ecological receptors has yet to be determined (in situations where the risk to ecological receptors is low to moderate, NR may be appropriate; however, in situations where the threat is immediate, corrective actions may be necessary to mitigate the threat); 2) appropriate cleanup levels for site-specific conditions without being under- or over-protective of ecological resources have yet to be determined; and 3) the presence of appropriate microbial species for the biodegradation of specific contaminants has yet to be determined. International Paper recognizes that

the NR recommendation may be premature in the ERA process and that several conditions necessary for NR are as of yet unknown; however, we predict that the outcome will be the same, i.e., that the ultimate decision by environmental risk managers will be to mitigate further degradation to the site-specific valued ecological resources by selecting the NR option.

Following EPA's review of the attached Preliminary CMS Report, and prior to EPA providing formal comments on the report, International Paper would like to meet with EPA at the Wiggins facility at the earliest convenience of EPA to discuss the findings of the Preliminary CMS activities and the logical and appropriate path forward to mitigate impacts and manage environmental risk at the Wiggins facility.

Please do not hesitate to call me at (901) 419-3878 if you need any additional information, have any questions or comments regarding the enclosed Preliminary CMS Report, or would like to coordinate the proposed meeting at the Wiggins facility.

Sincerely,



Tom Richardson

cc: Les Brewer, Premier Environmental Services, Inc.

References

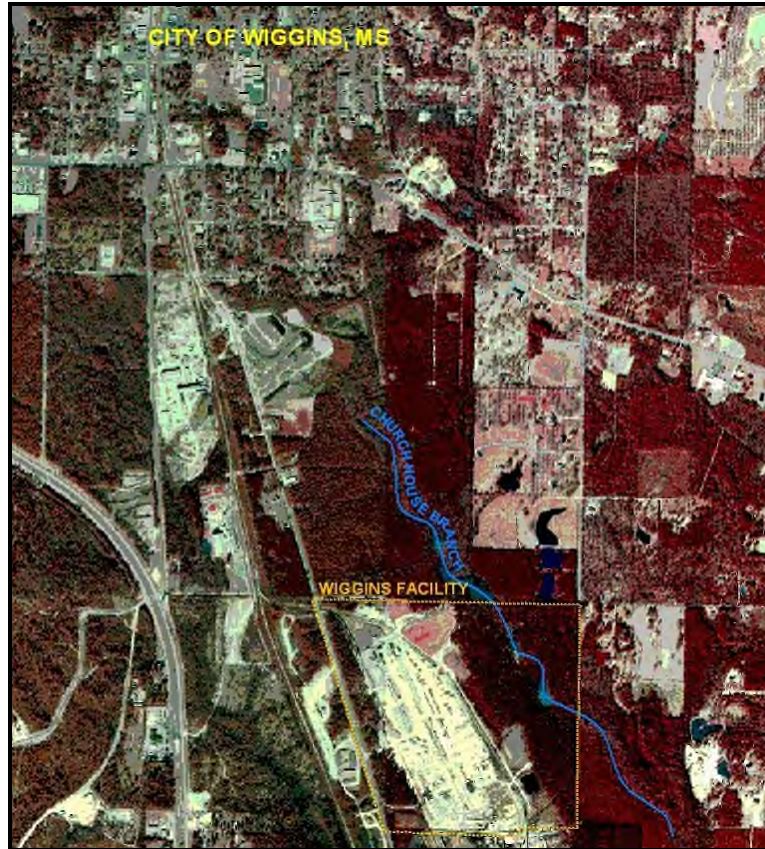
Premier. 2004. Corrective Measures Study Work Plan. International Paper Treated Wood Products Plant, Wiggins, Mississippi. Premier Environmental Services, Inc. June 2004.

Premier. 2002. RCRA Facility Investigation. Treated Wood Products Plant, Wiggins, Mississippi. Report. Premier, Venice, CA, 2002.

Preliminary Corrective Measures Study Report

International Paper Company

Treated Wood Products Plant, Wiggins, Mississippi



Prepared for:

**International Paper
International Place I
6400 Poplar Avenue
Memphis, TN 39197**

Prepared by:

**Premier Environmental Services, Inc.
146 North Canal Street, Suite 220
Seattle, WA 98109**

October 2005

INTERNATIONAL  PAPER


PREMIER
ENVIRONMENTAL SERVICES, INC.

Table of Contents

Table of Contents	i
List of Figures	iv
List of Tables	v
Appendices.....	vi
Acronyms and Abbreviations	vii
1 Introduction.....	1-1
1.1 Document Overview	1-2
2 Site Background and Current Conditions	2-1
2.1 Facility Location	2-1
2.2 Facility Operations.....	2-1
2.3 Regulatory History.....	2-1
2.4 Historical Releases.....	2-3
2.5 Environmental Setting	2-4
2.5.1 Regional Geology	2-4
2.5.2 Local Geology.....	2-4
2.5.3 Hydrogeology	2-5
2.5.4 Climate.....	2-7
2.5.5 Topography and Site Features	2-7
2.5.6 Surrounding Land Use	2-7
2.5.7 Habitats and Vegetative Communities.....	2-8
2.5.8 Animal Communities	2-10
2.6 Summary of RFI Findings	2-12
2.6.1 SWMUs 16, 17, 18, and 19.....	2-12
2.6.2 AOC A (Treated Wood Storage Areas)	2-12
2.6.3 SWMU 37 (Site Drainage Ditches), Forested Area between Facilities Operation and Church House Branch (AOC B)	2-13
2.6.4 Treatment Areas No. 1 and 2	2-13
2.6.5 AOC B (Church House Branch)	2-15
3 General Approach to the CMS.....	3-1
3.1 Areas of Investigation	3-1
3.1.1 SWMA 1	3-1
3.1.2 Area of Concern B (Church House Branch)	3-2
3.2 Corrective Measures/Investigation Approach.....	3-2
3.2.1 SWMA 1 (Treatment Areas 1 and 2 and the Site Drainage Ditches)	3-2
3.2.2 AOC B (Church House Branch)	3-3
3.2.3 Forested Area between the Facilities Operations Area and Church House Branch	3-4
4 CMS Objectives	4-1
4.1 Overall Objectives	4-1
4.2 Specific Objectives	4-1
5 CMS Investigation Activities.....	5-1

5.1	AOC B (Church House Branch) Surface Water and Sediment Investigation	5-2
5.1.1	Sample Station Selection Decision-Making Criteria	5-3
5.1.2	Sediment Sample Collection	5-4
5.1.2.1	Sediment Sampling Stations	5-5
5.1.3	Water Sample Collection	5-10
5.2	Forested Area between Facility Operations and Church House Branch – Soil Investigation	5-11
5.2.1	Soil Sample Collection	5-11
5.3	Sample Handling	5-13
5.4	Analytical Program	5-14
5.4.1	Sediment	5-14
5.4.2	Surface Water	5-15
5.4.3	Surface Soil	5-15
5.5	Sample Station Survey	5-15
5.6	Field Documentation	5-16
5.7	Data Evaluation and Usability	5-16
5.7.1	Data Evaluation	5-16
5.7.2	Data Usability	5-17
6	Constituents of Interest (COIs)	6-1
	Soil COIs	6-1
6.1	Sediment COIs	6-2
6.2	Surface Water COIs	6-3
7	Contaminants of Potential Ecological Concern (CoPECs)	7-1
7.1	Soil CoPECs	7-2
7.1.1	Inorganics	7-3
7.1.2	Chlorinated Phenols	7-3
7.1.3	Polycyclic Aromatic Hydrocarbons (PAHs)	7-4
7.2	Sediment CoPECs	7-5
7.2.1	Inorganics	7-6
7.2.2	Semivolatile Organic Compounds (SVOCs)	7-7
7.2.3	Polycyclic Aromatic Hydrocarbons (PAHs)	7-7
7.2.4	Other Constituents	7-8
7.2.5	Sediment CoPEC Summary	7-9
7.3	Surface Water CoPECs	7-9
7.3.1	Inorganics	7-11
7.3.2	Organic Compounds	7-11
7.3.3	Summary of Surface Water CoPECs	7-12
8	Discussion	8-1
8.1	Soils and Sediments	8-1
8.1.1	Soil CoPECs	8-1
8.1.2	Sediment CoPECs	8-2
8.1.3	Contaminant Fate in Soil and Sediment	8-3
8.2	Surface Water	8-6
9	Conclusions	9-1
9.1	Summary of Soil CoPECs	9-1

9.2	Summary of Sediment CoPECs	9-3
9.3	Summary of Surface Water CoPECs	9-4
9.4	Recommendation	9-5
10	References	10-1

List of Figures

- Figure 1. Wiggins Treated Wood Products Plant site location map
- Figure 2. Wiggins facility CMS SWMUs and AOC locations
- Figure 3. Sediment Sampling Locations
- Figure 4. Surface Water Sampling Locations
- Figure 5. Surface Soil Sampling Locations

Figures are included at the end of the tables after the main text.

List of Tables

Table 1.	Constituents of Interest – Soil
Table 2.	Constituents of Interest – Sediment
Table 3.	Constituents of Interest – Surface Water
Table 4.	Ecological Screening Values for Soils
Table 5.	Summary of occurrence of COIs and identification of CoPECs in Soil, based on conservative ESVs
Table 6.	Ecological screening values for sediments
Table 7.	Summary of occurrence of COIs and identification of CoPECs in Sediments, Church House Branch
Table 8.	Ecological Screening Values for Surface Water
Table 9.	Summary of occurrence of COIs and identification of CoPECs in Surface Water, Church House Branch

Tables are included at the end of the main text.

Appendices

Appendix A Quality Assurance Review of CMS data

Appendix B CMS Surface Water, Soil, and Sediment Results – Validated

Acronyms and Abbreviations

ADP	adenosine diphosphate
ATP	adenosine triphosphate
AOC	area of concern
AR	active remediation
ARCS	Assessment and Remediation of Contaminated Sediments
BERA	baseline ecological risk assessment
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CAP	Corrective Action Program
CCA	chromated copper arsenate
CCME	Canadian Council of Ministers of the Environment
CMS	Corrective Measures Study
COI	constituents of interest
CoPEC	contaminants of potential ecological concern
CoPC	contaminant of potential concern
CS-SIT	confirmatory sampling and structural integrity testing
CWQC	Canadian Water Quality Guidelines
DO	dissolved oxygen
DOE	U.S. Department of Energy
DOM	dissolved organic matter
DQOs	data quality objectives
ENR	enhanced natural remediation
EPA	U.S. Environmental Protection Agency
ERA	Ecological Risk Assessment
EQGs	Environmental Quality Guidelines
ESL	Ecological Screening Level
ESV	ecological screening values
ETC	Endangered, Threatened, or Candidate Species
ft	feet
HHRA	Human Health Risk Assessment
HPAH	high molecular weight polycyclic aromatic hydrocarbon
in.	inches
International Paper	International Paper Company
HSWA	Hazardous and Solid Waste Amendment
LEL	low-effects level
LPAH	low molecular weight polycyclic aromatic hydrocarbon
m	meter
MDEQ	Mississippi Department of Environmental Quality
MDL	method detection limit
MEK	methyl ethyl ketone
MS/MSD	matrix spike/matrix spike duplicate

NEC	no-effect concentrations
NAWQC	National Ambient Water Quality Criteria
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanic and Atmospheric Administration
NR	natural remediation
OMEE	Ontario Ministry of the Environment and Energy
ORNL	Oak Ridge National Laboratory
ORP	oxidation-reduction potential
PAH	polycyclic aromatic hydrocarbon
PCBs	polychlorinated biphenyls
PCP	pentachlorophenol
PEC	probable effect concentrations
PEL	Probable Effects Levels
Premier	Premier Environmental Services, Inc.
PVC	polyvinyl chloride
QAPP	Quality Assurance Project Plan
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA facility investigation
SAP	Sampling and Analysis Plan
SEL	Severe-Effects Level
SLERA	screening-level ecological risk assessment
SOP	standard operating procedures
SQG	Sediment Quality Guidelines
SQUIRTs	Screening Quick Reference Tables
SVOC	semi-volatile organic compound
SWMA	Solid Waste Management Area
SWMU	Solid Waste Management Unit
TEC	threshold effect concentrations
TEF	Toxicity Equivalency Factor
TEL	Threshold Effects Level
TOC	total organic carbon
TPAHs	total polycyclic aromatic hydrocarbons
TRC	tissue residue concentration
USFWS	United States Fish & Wildlife Service
VOC	volatile organic compound
WHE	Walk Haydel Environmental
Wiggins facility	International Paper's Treated Wood Products Facility in Wiggins, Mississippi
WWTF	wastewater treatment facility

1 Introduction

On behalf of International Paper Company (International Paper), Premier Environmental Services, Inc. (Premier) has prepared this Preliminary Corrective Measures Study (CMS) Report for evaluating the need for Resource Conservation and Recovery Act (RCRA) Corrective Actions at International Paper's Treated Wood Products Plant in Wiggins, Mississippi (Wiggins facility) (Figure 1); as well as identifying potential appropriate corrective measures. This Preliminary CMS Report was written in accordance with the U.S. Environmental Protection Agency (EPA) *Final Guidance on Completion of Corrective Action Activities at RCRA Facilities* (EPA 2003), the U.S. Department of Energy (DOE) *Resource Conservation and Recovery Act Corrective Action Program Guide* (DOE 1993), and the conditions listed in Appendix C of the Hazardous and Solid Waste Amendment (HSWA) permit modification for the Wiggins facility (EPA ID No. MSD 980 600 084) (EPA 1993a).

The objectives of the CMS Work Plan were to address data gaps identified in the EPA Region 4 response to the RCRA Facility Investigation (RFI) Report submitted to EPA Region 4 in November 2002 (Premier 2002), establish criteria for conducting the CMS, and to identify the need for potential remedies for completion of corrective measures at several Areas of Concern (AOCs) and Solid Waste Management Units (SWMUs) located at the Wiggins Facility. This Preliminary CMS Report specifically addresses potential corrective measures for four areas located within the Wiggins facility:

- Treatment Area 1 (SWMUs 21 through 25, 38, and 39)
- Treatment Area 2 (SWMUs 26 through 29, 32, and 33)
- Site drainage ditches (SWMU 37)
- Church House Branch (AOC B)

The scope of work proposed in the EPA-approved CMS Work Plan was based on results of the RFI conducted in February 2001. The purpose of the RFI was to investigate the potential releases of site-related chemicals in soil, sediment, and surface water, characterize the nature and extent of such releases, and identify actual or potential receptors that may be potentially exposed to site-related chemicals. Groundwater was not addressed in the RFI process since this environmental medium is being addressed site-wide under State of Mississippi Hazardous Waste Management Permit 980 600 084. The results of the RFI indicated that site-related chemicals did not extend to groundwater in the areas that were investigated. Detailed results of the RFI are presented in the RFI Report (Premier 2002).

In communications between EPA and International Paper, it was generally agreed that corrective measures for Treatment areas 1 and 2 would consist of institutional controls and continued operation of the Wiggins facility for industrial purposes (e.g. continued use for wood-treating operations). As such, the CMS Work Plan focused on activities involving the collection of additional data to address data gaps identified by EPA during its review of the RFI Report, as well as data gaps identified in the in the screening-level ecological risk assessment (SLERA) conducted as part of the RFI. Further, the CMS Work Plan outlined the approach to collect data in order to:

- assess the general water and sediment quality of Church House Branch both upstream and downstream of the Wiggins facility
- aid in determining the need for corrective measures in Church House Branch

In October 2004, these proposed additional data were collected.

1.1 Document Overview

This Preliminary CMS Report includes the following sections:

Introduction (Section 1): this section.

Site Background and Current Conditions (Section 2): describes the site layout as well as both historical and current operations conducted at the Wiggins facility. This section also summarizes the site's regulatory history—including known releases of site-related chemicals—as well as local and regional geology/hydrogeology, climate, area topography and site features, surface hydrology, regional climate, surrounding land use, and results of the RFI.

General Approach to the CMS (Section 3): establishes Solid Waste Management Areas (SWMAs) and summarizes the approach toward evaluating need for and completing corrective measures.

CMS Objectives (Section 4): describes the overall and specific objectives of the CMS and defines target objectives for corrective measures as well as data quality objectives for additional sample collection.

CMS Investigation Activities (Section 5): describes how CMS activities were conducted.

Constituents of Interest (COIs) (Section 6): describes how constituents of interest (COIs) were selected based on the analytical results.

Contaminants of Potential Ecological Concern (CoPECs) (Section 7): describes how the constituents of potential ecological concern (CoPECs) were selected.

Discussion (Section 8): presents a discussion identifying CoPECs that may be related to facility operations from those CoPECs that are clearly not. Also discussed are the potential risks posed by the CoPECs. These potential risks assist in identifying the most appropriate remedial solution, as well as identifying yet uncollected data that may assist in supporting the selection of such a solution.

Conclusions (Section 9): evaluates possible remedial actions and proposes a final remedial solution.

References (Section 10): provides a list of all references cited in this document.

2 Site Background and Current Conditions

2.1 Facility Location

The Wiggins facility is located in Stone County, Mississippi, approximately 2 miles south of the town of Wiggins, just east of U.S. Highway 49, in Section 31, Township 25 South, Range 11 West, at latitude 30° 51' 59" and longitude 89° 10' 54" (Figure 1). The Wiggins facility, which is located on 125 acres of land, has been operating at this location since December 1969. The Wiggins facility operations currently take place on approximately 85 acres of the site (Figure 2).

2.2 Facility Operations

Operations currently conducted at the Wiggins facility involve treating utility poles, pilings, and structural timbers with pentachlorophenol (PCP) and chromated copper arsenate (CCA). Wood-treating operations are conducted in two parallel treatment areas located in the northwestern portion of the Wiggins facility. PCP and CCA wood-treating operations are currently conducted in Treatment Area No. 1, and PCP wood-treating operations are conducted in Treatment Area No. 2. Historical wood-treating operations conducted at Treatment Area No. 2 also used creosote. Vehicle/equipment maintenance activities, pole-peeling, kiln drying, and pole framing activities are conducted in the southern portion of the Wiggins facility (Figure 2).

2.3 Regulatory History

In 1980, International Paper submitted a Part A Permit application for the Wiggins facility listing three surface impoundments as hazardous waste management units and

operated the surface impoundments under interim status until 1984. This permit was amended in 1981 to include two large hazardous waste storage tanks. In 1984, a Part B Post-Closure Permit application was submitted to EPA. EPA notified International Paper that the Part B Permit would have to be revised to include HSWA requirements. In 1986, the Mississippi Department of Environmental Quality (MDEQ) (formerly the Department of Natural Resources) and EPA approved the Wiggins facility's Part B permit application.

A closure plan for ten hazardous waste management units (SWMUs 1–10) was submitted in 1984 and was then modified several times, finally resulting in closure of ten SWMUs by 1989. The ten SWMUs are: the land treatment demonstration unit (SWMU 1); five sludge pits (SWMUs 2–6); and the recovery ponds for contact cooling water, creosote, PCP, and cellon (SWMUs 7–10). In 1991, MDEQ approved a closure plan for the two nonhazardous woodwaste landfills (SWMUs 11 and 12); these SWMUs were closed shortly thereafter.

In 1991, A.T. Kearney, Inc, under contract to EPA, conducted a RCRA Facility Assessment, which resulted in the identification of 39 SWMUs (including the 10 closed SWMUs described above) and two AOCs. In 1994, EPA issued a HSWA permit modification identifying several SWMUs, SWMU subunits, and AOCs that required confirmatory sampling and structural integrity testing (CS–SIT). The CS–SIT was performed by Walk Haydel Environmental (WHE) in early 1997, and the report was issued to EPA and MDEQ in April 1997 (WHE 1997). In July 1998, EPA requested that International Paper perform a RFI at the Wiggins facility. In June 2000, a RFI Work Plan was submitted (Exponent 2000) which EPA subsequently approved.

In 2001, Premier, on behalf of International Paper, conducted the RFI and submitted the results to EPA in 2002 (Premier 2002). Investigative and early removal actions performed during the RFI resulted in the closure of SWMUs 16 through 20. In May 2004, EPA requested that International Paper prepare and submit a CMS Work Plan to include remedial options for Treatment Area 1 (SWMUs 21–25, 38, and 39), Treatment Area 2 (SWMUs 26–29, 32, and 33), the onsite drainage ditches (SWMU 37), and

Church House Branch (AOC B). In addition, EPA requested that the CMS Work Plan provide an approach to collect additional data from the forested area between the operational areas of the Wiggins facility and Church House Branch to address data gaps identified in the SLERA. In effect, EPA acknowledged completion of the RFI and agreed to allow International Paper to address data gaps during the CMS.

2.4 Historical Releases

The Wiggins facility has had four recorded releases. The first release occurred in April 1983, when heavy precipitation caused the release of an estimated 150,000 gallons of untreated wastewater from the creosote recovery pond (SWMU 8) and the contact cooling water pond (SWMU 7). The wastewater was released into the drainage ditches (SWMU 37) that flow into Church House Branch (AOC B) (ATK 1991).

A second release (SWMU 38) occurred in October 1983 when the door of the large PCP treatment cylinder (SWMU 21A) failed, releasing approximately 30,000 gallons of PCP treatment solution. According to Wiggins facility personnel, berms and dams were constructed to prevent continued migration of these liquids to Church House Branch. All of the released material was reportedly recovered from Church House Branch by an outside contractor (ATK 1991).

A third release occurred in December 1983 when a valve on the creosote recovery pond opened, allowing approximately 24,000 gallons of untreated wastewater into the site drainage ditches (SWMU 37) (ATK 1991).

A fourth release occurred in 1985 when a frozen valve caused the release of approximately 100 gallons of PCP solution in the PCP treatment area. This release occurred prior to installation of secondary containment for both of the treatment areas. The spill was cleaned up with absorbent material. However, some of the PCP solution reportedly entered Church House Branch (ATK 1991).

2.5 Environmental Setting

The environmental setting is summarized below and described in greater detail in the RFI Report (Premier 2002).

2.5.1 Regional Geology

The Wiggins facility is located in the Longleaf Pine Hills division of the East Gulf Coastal Plain physiographic province, which extends from southwestern Georgia and northern Florida to the Mississippi River Valley. It is characterized by gently sloping, slightly dissected land surfaces that are interrupted by occasional subdued escarpments or cuestas that parallel the coastline. These features resulted in deposition and erosion of coastal terraces and deltas during the numerous advances and retreats of the Gulf of Mexico shoreline (LET 1984).

Soils in the region are generally light-colored sandy loams. These soils are acidic because of insufficient carbonates and/or carbonate leaching. The formations of interest near the Wiggins facility are the late Pliocene- or early Pleistocene-age Citronelle Formation and the Miocene-age Pascagoula Formation. The Citronelle Formation is generally characterized by silty, fine to gravelly, sands. The Pascagoula Formation is generally characterized by stiff to hard sandy clay with thin coarser grained layers in the upper portions of the formation that grades to silty sands, sandy silts, and sand with depth. Sand and gravels of the terrace deposits and recent alluvium are also present in the vicinity of the site (WHE 1998).

2.5.2 Local Geology

Soils of the Citronelle and Pascagoula formations have been encountered beneath the Wiggins facility during site investigations, and are consistent with the regional geological descriptions. Soils of the shallower Citronelle Formation encountered have consisted primarily of silty fine to gravelly sands and silty clay with varying amounts of sand.

During previous investigations, the Pascagoula Formation was encountered at depths ranging from approximately 108 to 121 feet (ft) above mean sea level—94 to 127 ft below ground surface (bgs). Soils of the Pascagoula Formation were documented as consisting primarily of stiff to very hard sandy clayey silt to silty clay with occasional thin gravel, sand, or silty sand layers in the upper portions of the formation. Silty sands, sandy silts, and sands were present at greater depths. The Pascagoula formation was encountered in each of the borings advanced to depths of greater than 90 ft bgs and is believed to be laterally extensive beneath the facility.

2.5.3 Hydrogeology

The Citronelle Formation is the uppermost water-bearing zone beneath the Wiggins facility and occurs under unconfined conditions. The groundwater flow direction in the Citronelle water-bearing zone beneath the Wiggins facility is generally toward the south. The hydraulic gradient generally averages between approximately 0.005 to 0.006 ft/ft. The potentiometric surface of this formation has been interpreted as intersecting the land surface near Red Creek, in an unnamed tributary to Red Creek south of the Wiggins facility, and in Church House Branch hydraulically upgradient of the facility (ATK 1991). Various hydraulic conductivity values have been reported for the Citronelle water-bearing zone beneath the Wiggins facility, resulting in a wide range of calculated groundwater velocity values. For example, Bath and Wampler (1984, reported by Hopper 1988) reported a range of observed hydraulic conductivity values from 3.8×10^{-3} to 1.3×10^{-4} cm/sec. Using these values, an assumed effective porosity of 0.2 and a hydraulic gradient of 0.005 results in calculated groundwater velocities that range from 0.009 ft/day to 0.27 ft/day. URS Corporation reported an average hydraulic conductivity value of 8.3×10^{-3} cm/sec (URS 1999). Assuming an effective porosity of 0.2 and a hydraulic gradient of 0.005, this hydraulic conductivity value results in a calculated groundwater velocity of 0.588 ft/day.

Recharge of the Citronelle water-bearing zone occurs through lateral inflow from adjoining portions of the formation and through direct infiltration of precipitation. Onsite

recharge is likely greatest in areas where sandy soils are present at the surface; which constitutes the majority of ground surface at the site.

Underlying the Citronelle Formation at the Wiggins facility is the Pascagoula Formation, whose uppermost member is characterized as a clayey silt that has been observed and interpreted to be 13 to 67.5 ft or greater in thickness and is thought to represent a relatively homogeneous, laterally continuous aquitard. This clayey silt member of the Pascagoula Formation consists of blue-green clay, silt, and occasionally sand. The continuity of this aquitard has been defined by several relatively deep borings (>224 ft bgs) at the Wiggins facility. Of these, WP-1 through WP-3 were completed as monitoring wells in the water-bearing sandy silt member of the Pascagoula Formation underlying the clayey silt member. Observed differences in water quality and piezometric heads between the Citronelle and the Pascagoula water-bearing zones support the observation that the clayey silt unit is an effective hydraulic barrier between these formations (WHE 1998).

The Pascagoula Formation is grouped together with the Catahoula, Hattiesburg, and Graham Ferry formations into a single aquifer system (the Miocene Aquifer System) because the similar lithologies of these formations make it difficult to distinguish between them in the subsurface. The Graham Ferry Formation has been interpreted as being absent beneath the Wiggins facility (WHE 1998). The Miocene Aquifer System consists of numerous water-bearing sand and gravel zones that are separated by clay and silt layers. Sand beds range from a few feet to several hundred feet thick and are generally lenticular in shape (WHE 1998).

The potentiometric head of the Miocene Aquifer System generally increases with depth, suggesting that the clay beds are effective at impeding flow between the sands. Results of aquifer tests in Stone County indicate that the mean transmissivity of these units is 11,000 ft²/day and varies between 3,400 and 48,000 ft²/day (WHE 1998). The Miocene Aquifer System generally outcrops north of the Wiggins facility. It is recharged both by precipitation falling on its outcrop area and by interaquifer leakage.

2.5.4 Climate

The climate in the Wiggins, Mississippi area is characterized by long, humid summers and mild winters. The mean annual temperature is 60°F and the average monthly temperatures range from 51°F in January to 82°F in July. Average precipitation ranges from 60 to 68 inches (in.) per year. March and July are the wettest months, providing an average of 6.64 to 8.32 in. of rainfall. October is the driest month, with a mean precipitation of 2.64 in. (LET 1984).

2.5.5 Topography and Site Features

Topographic relief within the property boundaries of the Wiggins facility ranges from approximately 200 to 250 ft above mean sea level (USGS 1983). The Wiggins facility is located on an approximately 1 mile-wide northwest-southeast trending ridge. The eastern portion of the facility lies within a subdued, wooded valley that drains toward Church House Branch. This area is topographically separated from the operational area of the facility by the northwest-southeast trending Illinois Central Railroad spur shown on Figure 2. One site ditch drains from the northern portion of the facility to Church House Branch, and three culverts pass under the railroad grade and drain portions of the operational areas of the facility (Figure 2). Approximately 2,100 ft of Church House Branch traverses the property. Church House Branch flows into Red Creek approximately 3 miles south of the site. Red Creek flows into the Pascagoula River.

2.5.6 Surrounding Land Use

The Wiggins facility is located in an industrialized area and has operated at this site since 1969. A plywood plant owned by Hood Industries is located on the property contiguous and south of the Wiggins facility. International Paper uses the property west of the facility for timber storage operations (see Figure 2); west of the timber storage area is the main Illinois Central Railroad right-of-way (see Figure 1). Located east and north of the facility are tracts of undeveloped wooded land.

Data obtained from Mississippi Bureau of Land and Water indicates there are 35 groundwater wells within one mile of the Wiggins facility. The City of Wiggins draws some of its public water from a well (Well No. 4) located on the Wiggins facility property near the northern facility site boundary and screened from approximately 1,240 to 1,330 ft bgs (Figure 2). The well is upgradient of the operational areas of the site. Additional detail regarding well locations and usage are provided in the RFI Report (Premier 2002).

Surface water is not withdrawn for public water supply in the immediate vicinity of the site. Red Creek is approximately 3 miles south of the Wiggins facility and is not used as a source of water supply. Church House Branch drains to Red Creek, and sections of Red Creek downstream of the confluence with Church House Branch are reportedly popular for canoeing (Roland 2000, pers. comm.). The nearest surface water supply downgradient of the site is the Pascagoula River in Pascagoula, Mississippi (ATK 1991).

2.5.7 Habitats and Vegetative Communities

Church House Branch is a small, first-order stream that originates in the southeastern portion of the City of Wiggins and flows southward about 6 miles to join Red Creek, a major tributary of the Black Creek system of the Pascagoula River Drainage. Church House Branch is intermittent in the uppermost reach extending from the northern Wiggins facility property boundary to the stream's origin in Wiggins and is a perennial ("blue-line") stream throughout most of its length from the Wiggins facility boundary to Red Creek (USGS 1983). Virtually all of Church House Branch within and downstream from the Wiggins facility property boundary contains a perennial aquatic habitat.

The aquatic habitat within AOC B consists of three semi-isolated beaver ponds, connected by discrete or braided stream channels of varying lengths, creating a mixture of lentic (sluggish or static) and lotic (flowing-water) water bodies that offer a wider variety of microhabitats within the overall reach than might otherwise be present near the headwaters of a first-order stream. A relatively flat riparian terrace, generally much

narrower on the west, extends laterally to varying widths from the Church House Branch channel. This "bottomland" appears to have historically supported a more or less continuous palustrine broad-leaved (hardwood) forest vegetative community along the entire reach contained within AOC B. The stream would likely have had a closed canopy throughout the reach, but the combination of selective logging and beaver activity appears to have created the open areas that are clearly evident. Both the vegetative community structure observed during the ecological reconnaissance, the 1996 aerial photography, and data collection events suggest that the basic habitat mix described above has been present for at least a decade. The riparian wetlands are now a mixture of bottomland hardwood forest (shallow swamp where flooded) and emergent herbaceous communities (marshes), with some transitional strips of scrub-shrub vegetation.

Adjacent to the riparian zones on either side of Church House Branch are forested slopes, neither of which is particularly steep except in localized areas near the crest on the western (Wiggins facility) side. On the western side, the terrain descends from about 230 feet above NGVD (National Geodetic Vertical Datum; essentially equivalent to "mean sea level") in the main facility area to about 190 feet NGVD along the riparian terrace. The slope is widest (hence the least steep) at the northern end, and gradually narrows (becoming steeper) toward the south. In contrast, the slope on the northeastern side of the stream is generally more gradual to, and beyond, the Wiggins facility property line. There is a broad swale, or secondary "valley," entering that of Church House Branch from the east around the latitude of the southernmost beaver pond, so that a large lobe of the pond spreads east-northeastward about halfway between the Church House Branch channel and the International Paper boundary. Another drainage pathway enters the Church House Branch valley from near the northeast corner of the property. This conveyance is represented, within International Paper property, by the remnant of a former tributary that appears to have been artificially channelized (i.e., straightened). Not far offsite, this stream has been dammed to create a farm pond.

Because of the steeper slopes along the western (facility) side of the valley, the transition between the wetland and upland vegetative communities is fairly abrupt. In contrast, a relatively broad band of seasonally or permanently (at the ponds) flooded or saturated terrain appears along the eastern side of Church House Branch. Near the northern end of the property is a relatively pure stand of mature sweet bay, which grades with southward progression into a mixture including Tupelo gum, wax myrtle, sycamore, and water oak. The understory includes small wax myrtle, yaupon, gallberry, and small sweet bay.

Although the upland slopes are entirely forested (except at various SWMUs adjacent to the main facility processing areas), the topography and apparent localized forest management practices have produced a remarkable variety of community composition and structure. This is especially true east of Church House Branch. In general, the slopes along the western side of the valley bottom are covered by relatively pure stands of younger loblolly pine at the northern end, an intermediate-age mixed but still heavily loblolly dominated stand in the middle, and a relatively mature mixed stand (still pine-dominated) to the south. In the latter area and to some extent in the middle, a few hardwoods (mainly water and cherrybark oaks) and longleaf pines contribute to the canopy. The understory is comprised mainly of yaupon, red maple, smaller cherrybark and other oaks, southern magnolia, sweetgum, and American holly.

Along the outer edges of the riparian terrace east of Church House Branch, the bottomland/swamp forest grades into a transitional community with increasing incidence of sweetgum, blackgum (replacing Tupelo), water oak, and laurel oak. Understory in this transitional zone becomes thicker, with the addition of small sweet bay, yaupon, and titi. Farther up the slope, pines (mainly loblolly) tend to be increasingly abundant and eventually dominate the canopy.

2.5.8 Animal Communities

The Church House Branch riparian terrace and forested wetland (bottomland/swamp forest) create a relatively “natural,” undisturbed, and secluded corridor in contrast to

higher terrain which has been largely developed for industrial, commercial, transportation-related, silvicultural, agricultural (primarily grazing), and residential uses. Although no biological sampling was performed during the 2001 ecological reconnaissance or the 2004 CMS soil, sediment, and surface water sampling, observations by experienced biologists indicate that the stream and beaver ponds probably support resident populations of semi-aquatic and strictly aquatic animals typical of such habitats in the region. Mosquitofish, small sunfish, bullfrog and cottonmouth were observed in or near shallow, marginal, portions of the ponds. Based on the amount of emergent vegetation, periphyton, leaf litter, and other detrital material, a moderately diverse and productive benthic invertebrate community would be expected; especially in the littoral portions of the ponds, which are extensive since they encompass flooded former riparian areas.

A number of terrestrial and semi-aquatic (i.e., amphibious) vertebrates, or “wildlife” have been identified that might be exposed to COIs associated with Church House Branch sediments. The upland and wetland habitats of Church House Branch would be expected to support a diverse assemblage of resident and transient wildlife, and as expected, a diverse assemblage of herpetofauna (amphibians and reptiles), birds, and mammals has been documented via direct visual observation and/or recognition of “sign” (tracks, scat, skeletal parts, and vocalizations). Observed herpetofauna include: southern toad, green treefrog, southern cricket frog, bullfrog, box turtle, Mississippi mud turtle, slider turtle, garter snake, speckled kingsnake, eastern cottonmouth, and southern black racer. Avian species include: Merriam’s turkey, turkey vulture, wood duck, great blue heron, red-tailed hawk, blue jay, brown thrasher, loggerhead shrike, American crow, red-winged blackbird, and numerous other common small forest, woodland, and “edge” dwelling forms (e.g., chickadee, American robin, northern cardinal, and sparrows). It is likely that a number of neotropical migrant songbirds, such as various warblers, utilize the area during spring and autumn migrations. Mammalian species recorded in the study area include: opossum, armadillo, beaver, gray squirrel, eastern cottontail (rabbit), raccoon, striped skunk, red fox, coyote, bobcat, and white-tailed deer.

The only federally-listed endangered, threatened, or candidate (ETC) species for which appropriate habitat might be available in the vicinity of the study area are upland forms with very specific vegetative cover requirements. These include: gopher tortoise, yellow-blotched map turtle, eastern indigo snake, black pine snake, red-cockaded woodpecker, and Louisiana black bear. None of these particular habitats were observed in AOC B.

2.6 Summary of RFI Findings

The following sections briefly describe the RFI findings and conclusions for each SWMU and AOC addressed during the RFI.

2.6.1 SWMUs 16, 17, 18, and 19

Clean closure was achieved for the SWMUs associated with the washing, maintenance, and fueling of vehicles (SWMUs 16, 17, 18, and 19; Figure 2). Therefore no additional investigative or remedial activities are warranted for these SWMUs.

2.6.2 AOC A (Treated Wood Storage Areas)

During the Human Health Risk Assessment (HHRA), no site-related chemicals were identified at concentrations that could be of concern for human health. Furthermore, the Wiggins facility areas which constitute AOC A are either not vegetated at all, or are in landscaped or ruderal cover, and therefore do not constitute significant habitat for ecological receptors. As such, no additional investigative or remedial activities are warranted for AOC A.

2.6.3 SWMU 37 (Site Drainage Ditches), Forested Area between Facilities Operation and Church House Branch (AOC B)

EPA determined that the SLERA performed as part of the RFI was too narrowly scoped with respect to the site drainage ditches, the forested area between facility operations and Church House Branch, and Church House Branch itself (AOC B).

While the SLERA may have been inappropriately scoped in the sense of omitting evaluation of drainage ditch “sediments” and soils on the western slope of AOC B, the results indicated a need for a further, refined ecological risk assessment (ERA). This expanded evaluation will incorporate screening of the soils and sediments of the ditches and forested terrain that descend to Church House Branch. However, with one possible exception, the substrates in the drainage ditches do not appear to be immersed or saturated long enough to sustain aquatic organisms, and therefore should be evaluated as soils. The RFI report was revised to identify the data gaps regarding the soils in the forested terrain that descend to Church House Branch. These additional data were collected during implementation of and in accordance with the CMS Work Plan.

2.6.4 Treatment Areas No. 1 and 2

Treatment Area No. 1 includes the PCP and CCA treatment cylinders and drip pads (SWMUs 21–23), the PCP and CCA work tanks (SWMUs 24 and 25), the sump/treatment area (SWMU 39), and the PCP spill area (SWMU 38). These areas are contiguous as shown on Figure 2.

Treatment Area No. 2 is located in the northwestern portion of the facility. Included in this area is the small PCP treatment cylinders (SWMU 26A), the former creosote cylinder (SWMU 26B), the small PCP collection pit (SWMU 26C), the PCP drip pads and tanks (SWMUs 27 and 28), the wastewater treatment facility (WWTF) (SWMU 29), the carbon concrete ditch (SWMU 32), and the boiler blowdown/process skimmer (SWMU 33)

(Figure 2). Similar to Treatment Area No.1, these SWMUs are contiguous as shown on Figure 2.

Surface and subsurface soil collected during the RFI contained contaminants of potential concern (CoPCs).

Results of the HHRA indicate the *current and future long-term worker* in Treatment Areas 1 and 2 had the highest cumulative risk estimates of 8×10^{-5} and 6×10^{-5} , respectively, due primarily to PCP and arsenic in surface soil in Treatment Area 1 and due to polycyclic aromatic hydrocarbons (PAHs) in surface soil in Treatment Area 2.

With respect to *construction worker* exposure, risk estimates were within the acceptable risk range identified by EPA. All estimates for construction worker exposure to soil from 0 to 17 feet bgs in Treatment Area 1 were less than the 1×10^{-6} risk level identified as the lower end of the acceptable risk range. The cumulative cancer risk estimate for construction worker exposure to soil from 0 to 17 feet bgs in Treatment Area 2 of 2×10^{-6} just slightly exceeded the lower end of the acceptable risk range.

The calculated human health risks in Treatment Areas 1 and 2 associated with CoPCs in the absence of any remedial action (i.e., under the no-action alternative) indicate acceptable risk ranges under an industrial scenario. However, select CoPCs in Treatment Areas 1 and 2 do exceed risk ranges under an unrestricted use level (residential levels). As such, under the current and expected future land use of ongoing industrial use of the Wiggins facility as a work place, no corrective measures to address CoPCs in shallow soils in Treatment Areas 1 or 2 are currently warranted. Institutional controls are anticipated to remain in place insofar as production operations are expected to continue at the Wiggins facility indefinitely. Furthermore, International Paper is obligated to continue post-closure activities associated with the closed surface impoundments as well as to continue performing corrective action to address groundwater affected with site-related CoPCs under the State of Mississippi Hazardous Waste Management Permit MSD

980 600 084. If land use at the Wiggins facility ever changes in the vicinity of Treatment Areas 1 and 2, the need for corrective measures in these areas should be reevaluated.

2.6.5 AOC B (Church House Branch)

As part of the RFI, six indicator locations and two background locations were sampled to evaluate the extent of occurrence of COIs in AOC B sediments. Analyses of the eight composite samples indicated that Church House Branch sediments contain elevated levels of certain metals (Cr, Cu, Pb)¹, a metalloid (As), a petroleum hydrocarbon mixture, certain PAHs, and PCP. The maximum reported concentrations of these COIs were compared to conservative benchmarks (i.e. ecological screening values) to determine if any has a potential to cause adverse ecological effects. The purpose of the sampling that occurred as part of the CMS investigation activities described in this document was to determine if chemicals that exceeded their respective ecological screening values require further evaluation in a refined ERA.

Eight individual semi-volatile organic compounds (SVOCs) and two groups were identified as potentially requiring further evaluation:

- Anthracene
- Total Low Molecular Weight Polycyclic Aromatic Hydrocarbons (LPAHs)
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(g,h,i)perylene
- Benzo(k)fluoranthene
- Chrysene
- Indeno(1,2,3-c)pyrene

¹ Nickel was reported at 2 mg/Kg in one indicator sample, but this concentration is an order of magnitude lower than levels generally regarded as unnaturally elevated.

- Total High Molecular Weight Polycyclic Aromatic Hydrocarbons (HPAHs)
- Pentachlorophenol (PCP)

3 General Approach to the CMS

This section describes the general approach to corrective actions and investigations that were performed at the Wiggins facility in accordance with the CMS Work Plan.

3.1 *Areas of Investigation*

Corrective measures were evaluated for the two treatment areas identified during the RFI. The two treatment areas were grouped into a SWMA as described below. To address data gaps, additional investigative activities were also performed in Church House Branch to evaluate surface water and sediment quality upstream and downstream of the Wiggins facility, and in the forested area between the operational area of the facility and Church House Branch.

3.1.1 SWMA 1

SWMA 1 consists of the following three RFI areas:

Treatment Area No. 1 (SWMUs 21 through 25, 38, and 39) – Treatment Area No. 1 is located in the northern portion of the Wiggins facility and includes the PCP and CCA treatment cylinders and drip pads (SWMUs 21 through 23), the PCP and CCA work tanks (SWMUs 24 and 25), the sump/treatment area (SWMU 39), and the PCP spill area (SWMU 38). These areas are contiguous as shown in Figure 2.

Treatment Area No. 2 (SWMUs 26 through 29, 32, and 33) – Treatment Area No. 2 is located in the northwestern portion of the Wiggins facility. Included in this area are the small PCP treatment cylinders (SWMU 26A), the former creosote cylinder (SWMU 26B), the small PCP collection pit (SWMU 26C), the PCP drip pads and tanks (SWMUs 27 and 28), the wastewater treatment facility (SWMU 29), the carbon concrete

ditch (SWMU 32), and the boiler blowdown/process skimmer (SWMU 33). Similar to Treatment Area No.1, these SWMUs are contiguous (Figure 2).

Site Drainage Ditches (SWMU 37) – SWMU 37 consists of approximately 6,800 linear feet of drainage ditches that direct stormwater away from the Wiggins facility. Three sections of drainage ditches are lined with concrete, including a small section of ditch just north of the two treatment areas and the ditches that run along the north and south side of the closed Recovery Ponds (Figure 2). The remaining ditches are unlined.

3.1.2 Area of Concern B (Church House Branch)

AOC B is equivalent to Church House Branch.

Area of Concern B (Church House Branch) – Church House Branch is located approximately 1,500 ft east and topographically downgradient of the main operations area of the Wiggins facility (Figure 2). Approximately 2,100 ft of this watercourse traverses the northeast portion of the International Paper property.

3.2 Corrective Measures/Investigation Approach

The following sections describe the approach used to determine the corrective measures for SWMA 1 as well as the investigative approach to further evaluate surface water and sediment quality in Church House Branch and to close the data gaps identified by EPA with respect to the forested hillside between the Wiggins facility's operations area and Church House Branch.

3.2.1 SWMA 1 (Treatment Areas 1 and 2 and the Site Drainage Ditches)

The results of the HHRA conducted in November 2002 showed that the potential risk is highest among current and future long-term workers. Exposures of onsite workers to soil

in Treatment Areas 1 and 2 would result in risk estimates of 8×10^{-5} and 6×10^{-5} , respectively. These estimates are within the risk range of 10^{-6} to 10^{-4} that is considered acceptable by the EPA. Furthermore, Treatment Areas 1 and 2 are expected to remain under industrial use and are not anticipated to convert to residential land use. Based on the estimated risks, continued access controls, and of the expected continuation of Treatment Areas 1 and 2 as industrial use areas, no further action is being proposed for these areas. Should land use in the vicinity of Treatment Areas 1 and 2 ever change, the need for corrective action should be reevaluated.

Despite limited access to the site drainage ditches (SWMU 37), the HHRA evaluated potential risks to adult and older child (i.e., 9–18 years old) trespassers. The results of the HHRA demonstrated that the potential risk is well below 10^{-6} , the most stringent level of acceptable risk. It is unrealistic to evaluate a residential scenario in the area where the site drainage ditches are located, and based on the premise that a only a trespasser—rather than an onsite resident—is the most at risk to come into contact with the sediments in the drainage ditches, no further action is warranted in these areas. Should land use in the vicinity of site drainage ditches ever change, the need for corrective action should be reevaluated.

3.2.2 AOC B (Church House Branch)

A phased approach is being implemented for the Church House Branch corrective measures study.

- **Phase 1** – Collect water and sediment samples upstream and downstream of the Wiggins facility in accordance with the CMS Work Plan (Premier 2004) to determine water quality and ambient contamination levels due to historic and ongoing activities both onsite and offsite.
- **Phase 2** – Evaluate the results of the water and sediment sampling efforts to determine the need for additional ERA activities and evaluate the need for potential remedial measures.

3.2.3 Forested Area between the Facilities Operations Area and Church House Branch

Additional data collection activities were conducted for the forested hillside between the facility operations area and Church House Branch in accordance with the CMS Work Plan. Surface soil samples were analyzed for CoPCs identified during the RFI to determine the extent of possible contamination in the drainage path of the culvert outfalls shown on Figure 2. The need for corrective measures was evaluated based on the analytical results of the collected samples.

4 CMS Objectives

4.1 Overall Objectives

The primary objective of the CMS was to collect sufficient data to determine the need for corrective actions in AOC B, as well as fill the data gaps regarding the soils in the forested terrain that descend to Church House Branch. No further action is warranted or proposed for SWMA 1 as described in Section 3.2. Specific objectives and remedial actions are presented below.

4.2 Specific Objectives

AOC B (Church House Branch) – The objective of the preliminary CMS activities for AOC B was to collect surface water and sediment samples of sufficient quality in order to characterize the upstream and downstream reaches of Church House Branch and to determine the need for additional ERA activities and/or determine appropriate remedial measures.

Forested area between the facility operations and Church House Branch – The objective for this area was to collect surface soil data of sufficient quality to determine the extent of CoPC migration in the facility drainage areas that lead to Church House Branch.

5 CMS Investigation Activities

This section of the Preliminary CMS Report provides a description of the field investigations that were conducted to meet the objectives described in the preceding sections. As stated previously, the media requiring further investigation during this CMS are soil, sediments and surface water; groundwater is currently being addressed under the existing groundwater corrective action program (CAP).

A descriptive overview of the field investigation activities are presented in this section. Detailed field procedures are included in the Sampling and Analysis Plan (SAP) in Appendix C of the RFI Work Plan (Exponent 2000) and the standard operating procedures (SOPs) provided as Appendices B through H of the CMS Work Plan (Premier 2004). The Quality Assurance Project Plan (QAPP) of the RFI Work Plan (Appendix E) defined the laboratory procedures and quality assurance/quality control (QA/QC) requirements and data quality objectives (DQOs) for analytical sampling and analysis that were performed during implementation of the CMS Work Plan. Health and safety procedures used during the field investigations are described in the health and safety plan in Appendix F of the RFI Work Plan (Exponent 2000).

CMS sample collection activities were planned for and executed at AOC B (Church House Branch) and the forested area between the facilities operations and Church House Branch. Sample collection activities were conducted in accordance with the RFI Work Plan SAP (Appendix C) (Exponent 2000) and Appendices A through M of the CMS Work Plan (Premier 2004). All physicochemical sampling and analysis procedures were conducted in accordance with the following guidance documents: The 2000 EPA *Estuarine and Coastal Marine Waters: Bioassessment and Biocriteria Technical Guidance* (Gibson *et al*, 2000), the 1998 EPA *Environmental Monitoring and Assessment Program – Surface Waters: Field Operations and Methods for Measuring the Ecological*

Condition of Wadeable Streams (EPA 1998), and the 1985 EPA *Sediment Quality Assurance Users Guide* (Barth *et al.* 1985).

Specific sample collection activities were conducted as described below.

5.1 AOC B (Church House Branch) Surface Water and Sediment Investigation

In order to assess the general sediment and surface water quality of Church House Branch in the vicinity of the Wiggins facility, surface water and sediment samples were collected from Church House Branch both upstream and downstream of the Wiggins facility boundaries. A total of 6 surface water samples (three upstream, one on the eastern facility boundary, and two downstream of the Wiggins facility) and 10 sediment samples (five upstream, one on the eastern facility boundary, and four downstream of the Wiggins facility) were collected to evaluate contaminant levels in Church House Branch.

Surface sediment grab samples were collected in October 2004 during fall low-flow conditions; however, the area had recently experienced a major hurricane event, and the sampling occurred during an unusually wet period. All sediment samples were collected using a manually operated stainless steel split-core sediment sampler with a stainless steel liner. Selection of the sampling locations and number of samples were based on the DQOs. The sampling included both systematic and judgmental sampling. Study regions on Church House Branch both upstream and downstream of the Wiggins property were identified such that sample transects were located systematically with the distance between sample locations increasing with distance downstream. For example, the study reach downstream of the City of Wiggins is approximately 5,200 ft. Sample stations would ideally be located at 0 ft, 330 ft, 1,000 ft, 2,300 ft, and 5,000 ft downstream of the city. However, given constraints of the DQOs, sample site selection decision-making criteria (see below), and physical constraints of the actual collection (such as the absence

of water in reach or accessibility to a site), samples were collected in locations determined by the sampler's best judgment.

5.1.1 Sample Station Selection Decision-Making Criteria

The following were used as preferred sediment sampling locations:

- Both banks of relatively straight section
- On the inside edges of meanders
- In slack water or eddy current areas
- In ponds, with grab samples biased towards the down current side of littoral drift

Due to unforeseen site conditions such as lack of suitable sediment for sampling, exploratory grab samples were collected in order to revise sampling locations in the field. As silts and clays are much more physically, chemically, and biologically interactive than larger grained particles due to their unbalanced electrical charges and greater surface-area-to-volume ratios, the grab sample should contain, as a goal, more than 30 percent fine-grained silts or clays (<0.06 mm) or smaller particle sizes by volume for an acceptable sample. Sample compositions were determined using a soil classification description and then field-estimated according to SOP 430 provided as Appendix K to the CMS Work Plan (Premier 2004). If exploratory grab samples met the criteria for the objectives of the study and contained less than 70 percent sand or larger particles, the site was sampled until the appropriate volume of sediment was collected. All sites met the criteria for the objectives of the study; if exploratory grab samples had not met this criteria or contained more than 70 percent sand or larger particles, the sample location would have been abandoned and an alternate location chosen. If no other suitable location met the criteria, a sample would be collected, but the results of the analysis would be annotated in the report with a description of the sample and the deviation from SOP 430 (Premier 2004).

Because the depth of the Church House Branch channel, averaging approximately 1.5 ft, did not necessitate deep-water samples, only shallow-water sediment samples were collected.

5.1.2 Sediment Sample Collection

Sediment samples were collected from the stream channel using clean, decontaminated stainless-steel 12-inch sediment corers. The corers were manually operated using either a T-handle for softer sediments or slide hammer for denser sediments, and they penetrated the sediment to a depth of approximately 12 inches. In order to obtain the appropriate volume of sediments for the suite of analyses, a total of 10 replicate cores were retrieved from each station, with the top 6 inches of each core retained for compositing and the bottom 6 inches discarded. The collective cores were composited in a polyethylene bag for subsequent homogenization in the lab. In the lab, replicate cores were placed in a clean and decontaminated stainless-steel bowl, homogenized with a clean and decontaminated stainless-steel spoon, and transferred to appropriate sample containers in accordance with the QAPP (Appendix E of the RFI Work Plan) (Exponent 2000). All sampling and mixing equipment was washed, degreased, decontaminated, and dried as per SOP 004 (Appendix E of the CMS Work Plan) (Premier 2004), between sampling events.

Physical and chemical field measurements were conducted prior to sampling within approximately three feet of the sediment sample. Overlying water column temperature, pH, dissolved oxygen (DO), oxidation-reduction potential (ORP) and conductivity were measured with a multi-probe system (YSI Model 556), with samples for turbidity collected by capped inverted-bottle method and measured with a portable spectrophotometer (HACH DR/2010). Because overlying waters were shallow (~ 1.5 ft), depth profiles for these parameters were not taken, and depth was measured with a measuring rod. Particle grain size was estimated by visual inspection, and surficial sediment samples (0- to 6-inch depth) were collected for subsequent laboratory analyses.

Sediment samples were visually inspected and logged for color (Munsell Soil Color Chart), texture (particle size description), and odor.

5.1.2.1 Sediment Sampling Stations

Sediment sampling stations were located and are described as follows:

SD01: This furthest downstream station was located directly west of the Ten Mile Baptist Church parking lot's northwestern boundary, approximately 160 ft north of the Ten Mile Church Road bridge over Church House Branch, and 6,150 ft downstream of the Wiggins facility boundary (Figure 3). The riparian zone (60 ft buffer) was comprised of deciduous trees plus shrubs and grasses, providing partial shading of the stream. The stream channel meandered with a mixture of run and pool sequences caused by coarse woody debris; the channel itself appeared relatively pristine and not channelized although moderate embankment erosion was evident, possibly due to recent hurricane events. The stream reach was characterized as shallow, low-gradient, and low velocity (<0.1 m/s); the stream width and depth were approximately 10 ft and 1 ft, respectively. No rooted or free-floating aquatic vegetation was observed, and benthic organisms were absent from the sediment cores. Sediment cores appeared normal, comprised mostly of fines, with normal odors and no abnormal deposits or oils. A surface water sample (SW01) was also collected from this location.

SD02: This downstream station was located directly east of Hood Industries property, approximately 330 ft downstream and south of an unimproved logging access road; this station was located approximately 2,800 ft downstream of the Wiggins facility boundary and 3,300 ft upstream of SD01 (Figure 3). The riparian zone (60 ft buffer) was comprised of mixed deciduous (tulip poplar, beech) forest providing partial shading of the stream. The stream channel meandered slightly with a mixture of mostly run sequences caused by coarse woody debris; the channel itself did not appear channelized although embankments were absent of vegetation and susceptible to erosion, possibly due to recent hurricane events. The stream reach was characterized as shallow, low-gradient,

and low velocity (<0.1 m/s); the stream width and depth were approximately 13 ft and 1.6 ft, respectively. No rooted or free-floating aquatic vegetation was observed, and benthic organisms were absent from the sediment cores. Sediment cores appeared normal, comprised mostly of fines, with normal odors and no abnormal deposits or visible sheen.

SD03: This downstream station was located directly east of the Wiggins facility boundary, approximately 32 ft downstream and south of the confluence with Church House Branch and Drainage Ditch D4 that drains Hood Industries property. This station was located approximately 1,580 ft upstream of SD02 (Figure 3). The riparian zone (60 ft buffer) was comprised of mixed deciduous (tulip poplar, beech) and loblolly pine forest providing full shading of the stream. The stream channel meandered slightly with run sequences interrupted by coarse woody debris; the channel itself did not appear channelized although embankments were absent of vegetation and susceptible to erosion, possibly due to recent hurricane events. The stream reach was characterized as shallow, low-gradient, and low velocity (<0.1 m/s); the stream width and depth were approximately 10 ft and 1 ft, respectively. No rooted or free-floating aquatic vegetation was observed, and benthic organisms were absent from the sediment cores. Sediment cores, comprised mostly of fines (silt and clay), were black in color and did not appear normal, having a petroleum-like odor as well as sludge deposits and a visible sheen present. A surface water sample (SW02) was also collected from this location.

SD04: This downstream station was approximately 650 ft directly east and downstream of the outfall to the second swamp/beaver pond, 330 ft directly east and downstream of the eastern boundary of the Wiggins facility, and 925 ft north and upstream of SD03/SW02 (Figure 3). The entire area is a forested wetland with extensive braiding of Church House Branch; the riparian zone (60 ft buffer) was comprised of mixed deciduous (tulip poplar, beech) and loblolly pine providing partial to full shading of the stream. The stream channel meandered extensively with a mixture of run sequences and near stagnant water pools caused by coarse woody debris. The channel itself did not appear

channelized although embankments were absent of vegetation and susceptible to erosion, possibly due to recent hurricane events. The stream reach was characterized as shallow, low-gradient, and low velocity (<0.1 m/s); the stream width and depth were approximately 5 ft and 1 ft, respectively. No rooted or free-floating aquatic vegetation was observed, and benthic organisms were absent from the sediment cores. Sediment cores, comprised mostly of fines (very fine sand, silt, and clay), did not appear normal, having petroleum-like odors with sludge deposits and a visible sheen present.

SD05: This onsite station was located on the eastern boundary of the Wiggins facility, approximately 330 ft directly east of the outfall to the second swamp/beaver pond and 288 ft directly west and upstream of SD04 (Figure 3). The entire area is a forested wetland with extensive braiding of Church House Branch; the riparian zone (60 ft buffer) was comprised of mixed deciduous (tulip poplar, beech) and loblolly pine providing partial to full shading of the stream. The stream channel meandered extensively with a mixture of run sequences and near-stagnant water pools caused by coarse woody debris. The channel itself did not appear channelized although embankments were absent of vegetation and susceptible to erosion, possibly due to recent hurricane events. The stream reach was characterized as shallow, low-gradient, and low velocity (<0.1 m/s); the stream width and depth were approximately 6 feet and 1 foot, respectively. No rooted or free-floating aquatic vegetation was observed, and benthic organisms were absent from the sediment cores. Sediment cores, comprised mostly of fines (very fine sand and clay), were very dark gray in color and did not appear normal, having petroleum odors, sludge deposits, and a visible sheen present. A surface water sample (SW03) was also collected from this location.

SD06: This upstream station was located in a cleared area of a natural gas line right-of-way approximately 200 ft directly north and upstream of the Wiggins facility's northern boundary and 3,680 ft northwest and upstream of SD05 (Figure 3). The riparian zone (60 ft buffer) was comprised of mixed deciduous herbaceous vegetation and grasses providing no shading of the stream. The stream channel run sequence appeared

channelized with no meander and no pools due to the presence of woody debris. Embankments were covered with vegetation and not susceptible to erosion. The stream reach was characterized as very shallow, low-gradient, and low velocity (<0.1 m/s); the stream width and depth were approximately 3 ft and <0.3 ft, respectively. Although no rooted and free-floating aquatic vegetation was observed, the benthos was covered with root mats from the embankment herbaceous vegetation and grasses. Benthic organisms were absent from the sediment cores. Sediment cores, comprised mostly of fines (silt and clay), were very dark gray in color and appeared normal with no odors, deposits, or visible sheens present. A surface water sample (SW04) was also collected from this location.

SD07: This upstream station was located approximately 790 ft directly south and downstream of a residential neighborhood and approximately 1,580 ft directly north and upstream of SD06 (Figure 3). The riparian zone (60 ft buffer) on the eastern side had been cleared of mature trees for an electric power right-of-way that ran parallel and adjacent to Church House Branch; the western side was comprised of mixed deciduous trees and grasses providing partial shading of the stream. The stream corridor was channelized with tall embankments (3 - 6 ft) and both run and pool sequences present due to unconformities of bedrock and sand deposition. Embankments were highly eroded and susceptible to continued erosion. The stream reach was characterized as mostly shallow, low-gradient and low velocity (<0.1 m/s); the stream width and depth was approximately 10 ft and 1.5 ft, respectively. No rooted and free-floating aquatic vegetation was observed. Benthic organisms were absent from the sediment cores. Sediment cores, comprised mostly of fines (silt and clay with fine sand), were light yellowish gray in color and appeared normal with no odors, deposits, or visible sheens present.

SD08: This upstream station was located approximately 32 ft directly north and upstream of a sewage lagoon and approximately 890 ft directly north and upstream of SD07 (Figure 3). Thirty three feet north of this station, the Church House Branch stream channel was non-existent. The riparian zone (60 ft buffer) was comprised of mixed

deciduous trees providing partial shading of the stream. The stream corridor did not appear channelized, and embankments were not susceptible. The stream reach was characterized as mostly shallow, low-gradient, and low velocity (<0.1 m/s); the stream width and depth were approximately 6 ft and 0.5 ft, respectively. Woody debris was abundant. No rooted or free-floating aquatic vegetation was observed. Benthic organisms were absent from the sediment cores. Sediment cores, comprised mostly of fines (silt and clay), were dark grayish brown in color and appeared normal with no odors, deposits, or visible sheens present. A surface water sample (SW05) was also collected from this location.

SD09: This upstream station was located approximately 330 ft directly south of State Highway 26, directly east of Stone Junior High School and approximately 650 ft directly north and upstream of SD08 (Figure 3). Twenty meters south of this station, the Church House Branch stream channel was non-existent, and existed as a dry culvert from this station north to State Highway 26. The riparian zone (18 m buffer) was comprised of mixed deciduous trees providing full shading of the stream. The stream corridor appeared channelized and embankments were susceptible to erosion. The stream reach was characterized as backwater or a shallow pool with no velocity (0 m/s) that contains water only after stormwater events or sewage overflow; the stream width and depth were approximately 5 ft and 0.5 ft, respectively. Woody debris was present but not abundant. No rooted and free-floating aquatic vegetation was observed. Mosquito larvae were abundant; however, no benthic organisms were observed in the sediment cores. Sediment cores, comprised mostly of fines (clay with coarse and fine sand), were dark grayish brown in color and appeared mostly normal with slight sewage odors, and no deposits or oils present.

SD10: This furthest upstream station was located approximately 82 ft directly north of State Highway 26 and 550 ft north and upstream of SD09 (Figure 3). Sixty five feet south of this station, the Church House Branch stream channel exists as a dry culvert that passes beneath State Highway 26, with standing pools of water in low areas at both the

proximal and distal ends of the culvert. The riparian zone (60 ft buffer) was comprised of mixed deciduous trees providing full shading of the stream. The stream corridor appeared channelized, and embankments were susceptible to erosion. The stream reach was characterized as a backwater or a shallow pool with no velocity (0 m/s) that contains water only after stormwater events or sewage overflow; evidence of this was a sewage manhole cover near the culvert that exhibited recent overflow; the stream width and depth were approximately 6 ft and 1 ft, respectively. Woody debris was minimal. No rooted or free-floating aquatic vegetation was observed. Mosquito larvae were abundant; however, no benthic organisms were observed in the sediment cores. Sediment cores, comprised mostly of fines (clay with some fine sand), were olive gray in color and appeared normal with slight sewage odors, and no deposits or oils present. A surface water sample (SW06) was also collected from this location.

5.1.3 Water Sample Collection

Because surface water contamination is likely to primarily show episodic releases of contaminants, a less intensive collection of six surface water samples (three upstream of the facility boundary, one on the eastern facility boundary, and two downstream of the facility boundary; Figure 4) was performed. Since this sample size will not support statistical calculation, the maximum concentration of each contaminant found was compared to benchmark values.

The water samples were analyzed *in situ* for temperature, DO, pH, electrolytic conductivity, and ORP with a multi-probe system (YSI Model 556); samples for turbidity were collected by capped inverted-bottle method and measured with a portable spectrophotometer (HACH DR/2010), according to SOP 102 (Appendix E of the CMS Work Plan) (Premier 2004). Depth profiles (surface, mid-depth, bottom) for these parameters were not made due the shallowness (<1.5 ft) of the stream thalweg; depth was measured with a measuring rod.

Water grab samples were collected using clean, decontaminated clear glass wide-mouth containers with Teflon lids, as deemed appropriate by field scientists toward meeting surface water DQOs. Water samples were collected by capped inverted-bottle method, with three rinses prior to the initial grab. Replicate grabs from each station were collected, composited in a clean and decontaminated split-churner and transferred to appropriate sample containers with preservatives as appropriate for each suite of analytes, in accordance with the QAPP (Appendix E of the RFI Work Plan) (Exponent 2000). All sampling and mixing equipment was washed, degreased, decontaminated, and dried as per SOP 004 (Appendix E of the CMS Work Plan) (Premier 2004), between sampling events.

Surface water samples were visually inspected and logged for clarity, color and odor. Surface water sample stations were co-located with sediment sample stations and identified with labeled surveyor's tape so that locations can be revisited, if necessary.

5.2 Forested Area between Facility Operations and Church House Branch – Soil Investigation

A total of 11 surface soil samples were collected to assess potential CoPC migration into the drainage path of the culvert outfalls topographically downgradient towards Church House Branch. As the topographic gradient decreases towards Church House Branch, the surface water flow originating from the culverts changes from channelized flow to sheet flow and/or braided flow. Surface soil samples were collected both in the drainage channels and within the areas of sheet flow and/or braided flow.

5.2.1 Soil Sample Collection

The CMS Work Plan (Premier 2004) proposed a soil sampling station array that maximized the aerial distribution and minimized the number of sample points. This methodology was essentially a variation of the nearfield-farfield approach used in predicting and measuring the aerial distribution of contaminants from primary and

secondary effluent discharge sources to aquatic system benthos. In marine and estuarine systems, the EPA recommends variations of the nearfield-farfield approach, replacing parallel transects with an open-grid station sampling array by adding sampling stations around the outfall. The open-grid pattern employs sample stations clustered around the outfall center and radiating outward downgradient. This EPA guidance is found in *Estuarine and Coastal Marine Waters: Bioassessment and Biocriteria Technical Guidance* (Gibson *et al*, 2000).

Proposed surface soil sample locations were selected in the field based on the EPA-recommended approach proposed above. Four culverts extend from the operational area of the facility in an east-west orientation beneath the railroad tracks, and at the head of the culvert (HC) empty into drainage ditches, designated D1 through D4, that extend easterly to Church House Branch (Figure 5). Three of the culverts (HC/D1, HC/D2 and HC/D3 emptying into D1, D2 and D3, respectively), provide stormwater drainage for the Wiggins facility; the fourth culvert outfall (HC/D4) was determined to be terminal (blocked), and it was determined that D4 did not drain the facility but rather upgradient property associated with Hood Industries (Figure 5). Consequently, soil samples were not collected from D4.

Soil sampling personnel collected samples from areas that showed evidence of frequent surface water flow attempting to mimic the proposed sample grid patterns presented in the CMS Work Plan as closely as possible. Soil samples were collected on October 13, 2004 from 11 locations (D1-1 through D1-4, D1-C, D2-C, D1/D2-C, and D3-1 through D3-4). Seven surface soil samples were collected within the sampling grid representing two of the three drainage outfalls (D1 and D2), and four surface soil samples were collected from drainage outfall D3. Each soil sample consisted of five subsamples: 1 subsample collected at the center of the sampling station, and 4 other subsamples located approximately 1.5 to 10 ft away from the center sample at cardinal positions, as dictated by limitations of the channel and alluvial delta.

D1 and D2 were determined to confluence early in a channelized and steep-gradient upland; consequently, soil samples were collected within an approximate 32 ft radius at the point of confluence (SL-D1/D2-C) and upstream in each channel (SL-D1-C and SL-D2-C). Two D1 samples were collected within the deciduous forested upland and within the steeply-walled channel (SL-D1-4 and SL-D1-3), one sample was collected in the deciduous forested wetland at the head of the alluvial delta (SL-D1-2), and one sample was randomly located and collected within the alluvial delta (SL-D1-1), also in the deciduous forested wetland, approximately 50 ft southeast of the smaller of the two beaver ponds. All D3 samples were collected in deciduous forested wetland; the easternmost sample (SL-D3-4) was collected within the low-gradient channel, and three samples (SL-D3-1, SL-D3-2, SL-D3-3) were collected within braided portions of drainage outfall D3 (Figure 5).

Each soil subsample was collected from a 0- to 6-inch depth interval using a clean, decontaminated, stainless-steel scoop and composited in a polyethylene bag. In the lab, an equal portion of soil from each subsample was placed in a clean and decontaminated stainless-steel bowl, homogenized using a clean and decontaminated stainless-steel spoon, and transferred to appropriate sample containers in accordance with the QAPP (Appendix E of the RFI Work Plan) (Exponent 2000). All sampling and mixing equipment was washed, degreased, decontaminated, and dried as per SOP 004 (Appendix E of the CMS Work Plan) (Premier 2004), between sampling events.

Surface soil samples were visually inspected and logged for lithologic description as described in the SAP of the RFI Work Plan (Exponent 2000).

5.3 Sample Handling

Each sediment, soil and surface water sample was properly labeled with a unique sample identification number as described in the Data Management Plan (Appendix D of the RFI Work Plan) (Exponent 2000), packed on ice in coolers and maintained at 4°C for

transport. Coolers were secured with fiberglass strapping tape. All samples were hand-carried to the nearest FedEx carrier and shipped overnight to the analytical laboratory with proper chain-of-custody procedures. Chain-of-custody forms were completed and signed by the project geologist and/or the project scientist at the end of each day and remained with the samples at all times, with separate chain-of-custody forms enclosed in each shipping container. Chain-of-custody forms specified sample date and time, sample identification number, sample description, sample type, sample preservation, and analyses required. Samples and signed chain-of-custody forms remained in the possession of the sampling crew for delivery to the FedEx carrier.

5.4 Analytical Program

All analyses were performed by Columbia Analytical Services, Inc. The analyses were conducted as described in Tables 4 through 17 of the CMS Work Plan (Premier 2004) and in accordance with the QAPP (Appendix E of the RFI work plan) (Exponent 2000). Appendix A presents all the validated CMS results and the Quality Assurance Review memo (data validation findings) is presented in Appendix B.

5.4.1 Sediment

Each composited and homogenized sediment sample was analyzed for volatile organic compounds (VOCs) by EPA Method 8260B, SVOCs by EPA Method 8270C, metals by EPA Method 6020, mercury by EPA Method 7471, chlorinated pesticides by EPA Method 8081A, polychlorinated biphenyls (PCBs) by EPA Method 8082A, organophosphorus pesticides by EPA Method 8141A, chlorinated herbicides by EPA Method 8151A, cyanide by EPA Method 9012A, pH by EPA Method 9045C, and total organic carbon (TOC) by EPA Method S1D-S3.

5.4.2 Surface Water

Each composited surface water sample was analyzed for VOCs by EPA Method 8260B, SVOCs by EPA Method 8270C, total metals by EPA Method 6020, total mercury by EPA Method 7470, chlorinated pesticides by EPA Method 8081A, PCBs by EPA Method 8082A, organophosphorus pesticides by EPA Method 8141A, chlorinated herbicides by EPA Method 8151A, cyanide by EPA Method 9012A, and hexavalent chromium by EPA Method 7196A.

5.4.3 Surface Soil

Each composited and homogenized soil sample was analyzed for the CoPCs identified during the RFI (Table 3 of the CMS Work Plan) (Premier 2004); specifically, PAHs and PCP were analyzed by EPA Method 8270C SIM, benzene by EPA Method 8260B, and arsenic and chromium by EPA Method 6020. In addition, samples were analyzed for TOC by EPA Method S1D-S3 and pH by EPA Method 9045D.

5.5 Sample Station Survey

Field personnel documented coordinates of physicochemical, sediment, surface water, and soil sampling stations with a GPS handheld computer unit (Trimble GeoXT). The GPS unit was downloaded and backed up daily. Sediment and surface water sample stations were also measured and identified with labeled surveyor's tape to aid in revisiting, if necessary. Soil sample locations were identified with labeled metal wire flags so that locations can be revisited, if necessary. In addition, waypoints were collected at various locations along the course of Church House Branch and the site drainage ditches leading to Church House Branch.

5.6 Field Documentation

Field personnel recorded all information, observations, measurements, and deviations from SOPs in a waterproof, bound, sequentially page-numbered field notebook. Entries included: names of field crew; location of site; date and time of sampling activities, including start and end time of collections; location of sample stations; number and volume of samples collected; sample identification numbers; field measurements and observations, and daily instrument calibration (YSI 556).

5.7 Data Evaluation and Usability

5.7.1 Data Evaluation

Data evaluation and management tasks were performed as specified in the CMS Work Plan. Field and analytical data collected during the CMS were entered into an electronic database for storage, retrieval, review, analysis, and reporting. Data evaluation was performed including a quality assurance review (data validation) of the laboratory analytical data (Appendix A).

The quality assurance review was performed on the analytical data in accordance with the procedures established in the following guidance documents:

- QA/G-8, *EPA Guidance on Environmental Data Verification and Data Validation* (EPA 2001a)
- *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA 1994)
- *Contract Laboratory Program National Functional Guidelines for Organic Data Review* (EPA 1999a)

A two tiered validation approach was used in the review of the data. An EPA Level III validation was performed on approximately half of the data; the remaining data were

subject to a cursory level validation. The following laboratory deliverables were reviewed during the cursory level validation process:

- Chain-of-custody documentation to assess holding times and verify report completeness
- Laboratory QC sample results, including method blanks, surrogate spikes, laboratory control samples, matrix spike/matrix spike duplicates, and laboratory duplicates
- Analytical results to verify reporting limits
- Field QC samples to assess field blank contamination and field duplicate precision.

The Level III validation consisted of all the elements of the cursory review plus the following:

- Instrument performance checks, including initial calibration, calibration verification, calibration blanks, instrument tuning, and interference checks

DQOs, project detection limits, and quality control sample frequencies from the CMS Work Plan were used in the evaluation of the analytical data. Qualifier codes were applied to results that did not meet method quality requirements or project DQOs. The qualifier codes were added to the hardcopy laboratory reports and the Premier database.

Data validation was documented on worksheets (archived by Premier) and in the validation memorandum titled *Data Quality Assurance Review* (Appendix A).

5.7.2 Data Usability

The DQOs of the CMS Work Plan were met for the project data, with the exceptions noted in the Data Quality Assurance Review memorandum (Appendix A). Project data were qualified as estimated or estimated detection limit for any of the following reasons: holding time exceeded, instrument performance checks not meeting criteria, surrogate

recovery, matrix spike/matrix spike duplicate (MS/MSD) recovery, laboratory control sample recovery, or field duplicate imprecision. Several results were determined to be false positive results caused by laboratory or field contamination and were qualified as undetected. The vinyl acetate result of sample SD6009 (station SD-09) was rejected because the matrix spike and matrix spike duplicate results were both below 10 percent recovery. The organophosphorus pesticide results of sample SW6006 (station SW-06) were rejected because the surrogate recovery was below 10 percent. Rejected results may not be used for any purpose; however, estimated results are useable for most purposes including corrective measures studies. With the exception of rejected results, the project data are usable for corrective measures evaluation.

6 Constituents of Interest (COIs)

This section describes how constituents of interest (COIs) were selected based on the analytical results. For the forested area, the COIs were selected from the CoPCs already identified during the RFI. For the surface water and sediment samples from Church House Branch, the COIs were selected based on contaminant concentrations.

Soil COIs

The combined results for all soil samples are shown in Table B-1 in Appendix B. A summary of soil samples with concentrations equal to or greater than the method detection limit (MDL) are shown in Table 1. For purposes of the CMS, soil COIs are those analyte concentrations equal to or greater than the MDL and include:

- Arsenic and chromium
- All 17 PAH compounds
- PCP

In general, the highest concentrations of contaminants were found associated with either Drainage Ditch 1 or Drainage Ditch 2, and concentrated at the confluence of the two ditches where steep, channeled walls were prominent. The highest concentration of chromium (65.8 mg/Kg) was found in sample D1-C collected from Drainage Ditch 1 within a few meters upgradient of the confluence with Drainage Ditch 2. The highest concentrations of arsenic (28.8 mg/Kg) and two LPAHs, 2-Methylnaphthalene (1.5 µg/Kg) and naphthalene (1.6 µg/Kg), were found at the confluence of Drainage Ditch 1 and Drainage Ditch 2. The highest concentrations of PCP (5,400 µg/Kg) and remaining PAHs occur in sample D2-C collected from Drainage Ditch 2 within a few meters upstream of the confluence with Drainage Ditch 1.

6.1 Sediment COIs

The combined results for all sediment samples are shown in Table B-2 in Appendix B. A summary of sediment samples with concentrations equal to or greater than the MDL are shown in Table 2. Data in the table have been organized to show results in the opposite direction of the stream flow starting at the southernmost sample collected southeast of the Wiggins facility boundary, to samples collected upstream of the Wiggins facility in the City of Wiggins, .

In general, the highest concentrations of PCP (1,500 µg/Kg) and remaining PAH contaminants were found offsite at SD04, several hundred meters downstream and directly east of the outfall of Drainage Ditch 3 (D3). The highest concentrations of metals, with the exception of beryllium and cobalt, were scattered throughout upstream sample stations (SD06 through SD10). The highest concentrations of the VOCs 2-butanone (methyl ethyl ketone {MEK}) and toluene and the metals beryllium and cobalt occurred downstream of the facility at SD03 and SD01. For purposes of the CMS, sediment COIs are those analyte concentrations equal to or greater than the MDL and include:

- All total metals, including mercury, detected in at least one sediment sample from Church House Branch
- VOCs 2-butanone (MEK), acetone, and toluene detected in at least one sediment sample from Church House Branch
- SVOCs PCP, 4-methylphenol, benzyl alcohol, bis(2-ethylhexyl)phthalate, dibenzofuran, hexadecanoic acid, 1-phenanthrenecarboxylic acid, 1,2,3,4, hexadecane, beta-sitosterol, and ergosterol) detected in at least one sediment sample from Church House Branch
- All 17 PAHs detected in at least one sediment sample from Church House Branch
- Inorganic constituent cyanide detected in at least one sediment sample from Church House Branch

6.2 Surface Water COIs

The combined analytical results for all surface water samples collected in October 2004 are shown in Table B-3 in Appendix B. A summary of surface water samples with concentrations equal to or greater than the MDL showing frequency of detection as well as minimum and maximum concentrations detected are shown in Table 3. Data in both tables have been organized to show results in the opposite direction of the stream flow starting at the southernmost sample collected south of the of the Wiggins facility boundary, to samples collected north upstream of the Wiggins facility in the City of Wiggins

In general, the highest concentrations of surface water contaminants were found offsite at the most upstream sample station (SW06) in the City of Wiggins; exceptions to this are arsenic (16 µg/L), chromium (6.33 µg/L), and cobalt (1.24 µg/L), all found in SW03 located at the Wiggins facility eastern boundary; barium (41.8 µg/L), found upstream of the facility at SW05; and thallium (0.22 µg/L) and hexavalent chromium (3.0 µg/L) found furthest downstream at SW01. For purposes of the CMS, surface water COIs are those analyte concentrations equal to or greater than the MDL and include:

- 15 total metals and hexavalent chromium detected in at least one surface water sample from Church House Branch
- VOCs 1,4-dichlorobenzene, 2-butanone (MEK), acetone, chloroform, dichloromethane (methylene chloride), and toluene detected in at least one surface water sample from Church House Branch
- SVOCs 4-methylphenol, benzyl alcohol, bis(2-ethylhexyl)phthalate, butylbenzylphthalate, diethyl phthalate, and phenol detected in at least one surface water sample from Church House Branch
- Chlorinated herbicide 2,4,5-TP (silvex) detected in at least one surface water sample collected from Church House Branch

- Inorganic constituent total cyanide detected in at least one surface water sample collected from Church House Branch

With few exceptions as noted earlier, concentrations of surface water chemicals qualifying as COIs were higher north (i.e. upstream) of the Wiggins facility than concentrations observed in samples collected on or south (i.e. downstream) of the Wiggins facility.

7 Contaminants of Potential Ecological Concern (CoPECs)

As a component of any environmental investigation/remediation program, the ERA includes identification of those constituents present in the environmental media with the potential to adversely affect ecological receptors in the ecosystem. The typical methodology is to compare the maximum identified concentrations of COIs at the site of interest with regulatory or technically defensible ecological screening values (ESVs). ESVs represent conservative thresholds at or above which adverse toxicological responses in invertebrate organisms may occur. In identifying those COIs considered in this Preliminary CMS that exceed the appropriate ESVs and may pose hazards to ecological resources, such COIs are elevated to CoPEC status and may be subject to further evaluation in a more definitive baseline ecological risk assessment (BERA).

The process of screening COIs for possible elevation to CoPEC status, by necessity, results in the elimination of some COIs or relegation to the status of uncertainties that can only be addressed qualitatively or intuitively. For those COIs where practical reporting sensitivities (i.e., analytical reporting limits) are inadequate to verify the absence of COIs at levels exceeding ESVs, or for those COIs for which ESVs are not available, the constituents are considered uncertainties rather than CoPECs.

A listing of the ESVs that were selected from criterion or guidance documents are presented alphabetically for soil, sediment and surface water media in Tables 4, 6, and 8, respectively. A listing of the CoPECs and uncertainties identified for further evaluation are presented alphabetically for soil, sediment and surface water media in Tables 5, 7, and 9, respectively.

7.1 Soil CoPECs

To evaluate potential ecological ramifications of the collected soil data, ESVs were selected from available criterion and guidance documents. Ecological screening values for soils are presented in Table 4. The available soil screening values are limited to those benchmarks issued by:

- Canadian Council of Ministers of the Environment (CCME) Environmental Quality Guidelines (EQGs) Soil Target Benchmarks for agricultural, residential/park, commercial and industrial uses (CCME 2003);
- Dutch Ministry Standards, used preferentially by EPA Region IV (Crommentuijn et al 1997; MHSPE 1994);
- Oak Ridge National Laboratory (ORNL) Soil Screening Values based on toxicity to soil invertebrates and microorganisms (Efroymson *et al* 1997a) and phytotoxicity (toxicity to plants) (Efroymson *et al* 1997b);
- EPA Region IV Soil Screening Benchmarks (EPA 2001c; EPA Region IV 1995) and Region 5 RCRA Ecological Screening Level (ESL) Soil Screening Benchmarks (EPA 2003);
- United States Fish & Wildlife Service (USFWS) Soil Screening Values (Beyer 1990).

The recommended soil screening values selected (Table 5) represent the lower or most conservative value, with the most conservative EPA Region IV Soil Screening Benchmarks (EPA 2001c) being the preferred source. If EPA Region IV values were not available, the most conservative values from CCME EQGs Soil Target Benchmarks (CCME 2003) were used. If no CCME values were available, the most conservative values from ORNL Soil Screening Values (Efroymson *et al* 1997a; Efroymson *et al* 1997b) were used. All of the ESVs listed are experimentally derived, effects-based, and consensus-based values believed to represent thresholds below which adverse responses

are highly unlikely. Preference was given to EPA Region IV, CCME, and ORNL values, listed in decreasing order of preference. This is because they represent a compilation of the most conservative benchmarks available for soil that have a solid technical basis, are the most recently published in peer-reviewed scientific literature, and for many, there is close interagency concurrence between values. For many constituents, multiple sources for soil screening values are few or unavailable, and in several cases only single values are available.

Table 1 summarizes soil sampling station-specific COI concentrations and Table 5 summarizes soil COIs showing frequency of detection as well as minimum and maximum concentrations detected, comparing hypothetical potential exposures with ESVs. As described earlier, the selected ESVs are considered suitable for direct exposure evaluations and are not expected to elicit adverse ecological effects. Soil ESVs were available for all inorganic chemicals, PCP, and select PAHs identified as COIs.

7.1.1 Inorganics

Arsenic and chromium identified as COIs in soil samples collected from the drainage ditches located in the forested area between the facility operational area and Church House Branch exceed benchmarks and are considered CoPECs. Total chromium exceeded benchmarks in all soil sample stations, and arsenic was identified as a CoPEC in all D1 and D2 sample stations. The foregoing suggests that chromium and arsenic may pose a risk to sensitive soil invertebrate species.

7.1.2 Chlorinated Phenols

Three of the 12 reported soil concentrations of PCP exceeded direct-exposure pathway ESVs at sample stations located at or near the vicinity of the confluence of drainage ditches D1 and D2; specifically, immediately upstream of the confluence (D2-C: 5.40 mg/Kg and D2-C field duplicate: 0.11 mg/Kg) and at the confluence (D1/D2-C: 0.23 mg/Kg). Therefore, PCP is identified as a CoPEC for direct pathway exposures,

suggesting that PCP may pose a risk to sensitive soil invertebrate species. It should be noted that these direct-exposure pathway ESV exceedances are limited to soil samples collected within a very small area within the soils of narrow and steeply-walled channels located in and at the confluence of ditches D1 and D2 (Figure 5).

7.1.3 Polycyclic Aromatic Hydrocarbons (PAHs)

Ten individual PAH compounds (2 LPAHs and 8 HPAHs) and one PAH group (Total PAHs [TPAHs]) exceeded their respective ESVs for direct exposure to soil invertebrate organisms (Table 5). The ESVs exceeded for anthracene and for almost all individual HPAHs (benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, fluoranthene, and pyrene) as well as Total HPAHs were associated with sampling stations D2-C and D1/D2-C, with three compounds (phenanthrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene) also exceeding their direct-exposure ESVs at D2-C. Thus, ESVs exceeded for individual PAHs and TPAHs occurred exclusively at two sampling stations located in a very small area at and upstream of the confluence of drainage ditches D1 and D2—specifically, within the soils of narrow and steeply-walled channels of sample stations D2-C and D1/D2-C. However, as no suitable ESVs were identified for several of the individual PAH compounds (2-methylnaphthalene, benzo(g,h,i)perylene, acenaphthylene and chrysene) or for two PAH groups (LPAHs and HPAHs), these chemicals are automatically relegated to uncertainties for further evaluation. If chemicals identified as uncertainties are included with those PAHs exceeding their respective ESVs for direct exposure to soil invertebrates, then as many as 14 individual PAH compounds (4 LPAHs and 10 HPAHs) and three PAH groups (Total LPAHs, Total HPAHs, and Total PAHs) may pose a risk to sensitive soil invertebrate species, even though the extent of the soil contamination appears to be confined within a very small area (<30 ft²). Surface soil sample stations are shown on Figure 5.

7.2 Sediment CoPECs

To evaluate the ecological ramifications of the sediment data, ESVs were selected from available criterion and guidance documents. Ecological screening values for sediments are presented in Table 6. The available sediment screening values are limited to those benchmarks issued by:

- EPA Assessment and Remediation of Contaminated Sediments (ARCS) Program threshold-effect concentrations (TEC), probable-effect concentrations (PEC), and high no-effect concentrations (NEC) for freshwater sediment concentrations (EPA 1996);
- Consensus-based Sediment Quality Guidelines (SQG) TEC and PEC (MacDonald *et al* 2000);
- Dutch Ministry Standards Target and Intervention Values, used preferentially by EPA Region IV (Crommentuijn *et al* 1997; MHSPE 1994);
- National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (SQUIRTs), Threshold Effects Level (TEL) and Probable Effects Level (PEL) (Buchman 1999);
- Ontario Ministry of the Environment and Energy (OMEE) Low-Effects Level (LEL) and Severe-Effects Level (SEL) Ecological Benchmarks (Persaud *et al* 1993);
- EPA Region IV Sediment Screening Benchmarks (EPA 2001c; EPA Region IV 1995; Region 5 ESL Sediment Screening Benchmarks (EPA 2003), and Region VI Sediment Screening Benchmarks: Freshwater Sediment (TNRCC 2001).

The recommended sediment ESVs selected (Table 7) represent the lowest or most conservative value available believed to represent thresholds below which adverse effects to sensitive invertebrates are highly improbable. The rationale used for the preferential

selection of the most conservative benchmarks emphasizes a solid technical, albeit hyper-conservative, approach: for this evaluation only those benchmarks available for freshwater sediments were considered, and of those benchmarks, those considered are consensus-based and represent the most recently published in peer-reviewed scientific literature. On this basis, preference was given to ARCS TEC (EPA 1996), Consensus-based TEC (MacDonald *et al* 2000), NOAA ARCS TEL and PEL (Buchman 1999), OMEE LEL (Persaud *et al* 1993), Dutch Ministry Standards (Crommentuijn *et al* 1997; MHSPE 1994) and EPA Region IV (EPA 2001c), Region V (EPA 2003), and Region VI (TNRCC 2001). As with soils, for many constituents, multiple sources for sediment screening values are few or unavailable, and in several cases only a single value is available.

A summary of sediment COIs showing sampling station-specific concentrations are presented in Table 2, and sediment COI frequency of detection, minimum and maximum concentrations detected, and a comparison of hypothetical potential exposures with ESVs are presented in Table 7. The selected ESVs are considered suitable for direct exposure evaluations, and as described earlier, are not expected to elicit adverse ecological effects in invertebrate organisms. Indirect exposure pathways were calculated for several of the sediments as well. ESVs were available for most inorganic chemicals, most SVOCs, and all PAHs. However, no suitable ESVs were identified for several of the metals (beryllium, thallium, tin, and vanadium) and SVOCs (beta-sitosterol, ergostanol, hexadecane, hexadecanoic acid and 1-phenanthrenecarboxylic acid 1,2,3,4,4). These chemicals are automatically relegated to uncertainties for further evaluation.

7.2.1 Inorganics

Following comparison to direct and indirect ESVs, two metals were identified as sediment CoPECs: lead at sampling stations SD08 and SD10 and mercury at sampling station SD08. However, both sampling stations are located upstream of the Wiggins facility; hence, this metal contamination is not related to onsite operations, and the source of contamination is likely the City of Wiggins stormwater-associated sewage overflow

(see Figure 3 for sediment sampling station locations). As described earlier, beryllium, thallium, tin and vanadium were identified as uncertainties for potential further consideration; however, tin was detected only in samples upstream of the Wiggins facility and therefore is not associated with facility operations. Vanadium was detected in all sediment samples collected along Church House Branch at concentrations ranging from 7.9 to 37.3 $\mu\text{g/Kg}$ in samples in no discernable pattern, so it is unlikely that the source of vanadium is related to Wiggins facility operations. Beryllium was detected at sample stations upgradient, downgradient, and adjacent to the Wiggins facility in no discernable pattern, so it is unlikely that the source of beryllium is related to the Wiggins facility operations. Thallium was detected in three upstream sediment samples and the most downgradient sample, but not in samples adjacent to the Wiggins facility, so it is unlikely that the source of thallium is related to Wiggins facility operations.

7.2.2 Semivolatile Organic Compounds (SVOCs)

Three SVOCs (4-methylphenol, benzyl alcohol and PCP) were identified as CoPECs at sediment sampling station SD04, and of these, two (4-methylphenol and PCP) were identified as CoPECs at station SD05. PCP was additionally identified as a CoPEC at stations SD01 and SD03. As described earlier, five additional SVOCs (beta-sitosterol, ergosterol, hexadecane, hexadecanoic acid and 1-phenanthrenecarboxylic acid 1,2,3,4,4), all identified at SD01, were relegated to uncertainties due to a lack of suitable ESVs. Sediment sampling stations SD04 and SD05 are located in wetlands adjacent to the Wiggins facility; hence, SVOC sediment contamination onsite is potentially associated with facility operations or the City of Wiggins, and sediment contamination downstream (SD01 and SD03) is potentially associated with , the City of Wiggins, International Paper facility operations, or operations conducted at Hood Industries.

7.2.3 Polycyclic Aromatic Hydrocarbons (PAHs)

PAHs were almost completely undetectable upstream of Wiggins facility operations (Table 2), and only benz(a)anthracene exceeded selected ESVs at sediment sampling

station SD10 (Table 7). Seven LPAHs (2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene and phenanthrene), six HPAHs (benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene and pyrene) and three groups (Total PAHs, Total LPAHs and Total HPAHs) were identified as CoPECs at station SD04. In addition, phenanthrene and pyrene were identified as CoPECs at station SD03, and benz(a)anthracene was identified as a CoPEC at station SD10. Benzo(g,h,i)perylene was not identified as a CoPEC, and benzo(a)pyrene dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene were not detected at any sediment sampling stations; however, because the CoPEC evaluation is based on selection of highly conservative screening values—typically those where toxic responses would rarely be observed—some of the non-detect compounds can be included for conservatism (as discussed in the SLERA) when concentrations of individual compounds are added together to estimate exposures to classes of PAHs. In summary, up to 13 individual PAH compounds (7 LPAHs and 6 HPAHs) and three PAH groups (Total LPAHs, Total HPAHs, and Total PAHs) exceed their respective ESVs and could potentially pose a risk to sensitive sediment invertebrate species. Similar to the extent of PAH soil contamination, sediment PAH contamination appears to be limited to a relatively small area on Church House Branch, a confined area near sampling station SD04 where almost all PAH COIs exceed their respective ESVs.

7.2.4 Other Constituents

In sediment samples, cyanide was identified as exceeding benchmarks at all stations and is therefore considered a CoPEC. This suggests that cyanide may pose a risk to sensitive sediment invertebrate species. Cyanide was detected in all sediment samples ranging in concentration from 0.12 mg/Kg to 0.23J mg/Kg and in no discernable pattern along Church House Branch. Furthermore, cyanide is not used in operations conducted at the Wiggins facility. Therefore is unlikely that the source of cyanide is related to Wiggins facility operations.

7.2.5 Sediment CoPEC Summary

To summarize sediment CoPEC results, those that are relevant to this preliminary CMS are CoPECs that occur onsite (sampling station SD05) and downstream of the Wiggins facility (sampling stations SD01 through SD04). CoPECs at these stations include three metals (beryllium, thallium, and vanadium), eight SVOCs (1-phenanthrenecarboxylic acid, 1,2,3,4,4, 4-methylphenol, benzyl alcohol, beta-sitosterol, ergosterol, hexadecane, hexadecanoic acid, and PCP), 13 individual PAH compounds (2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluorene, fluoranthene, naphthalene, phenanthrene, and pyrene), three PAH groups (LPAHs, HPAHs, and Total PAHs), and cyanide.

The results of this latest data collection and evaluation event closely approximates the results of the SLERA, in which none of the inorganic COIs (arsenic, chromium, copper, lead, nickel) were elevated to CoPEC status (Exponent 2002); in this analysis, however, beryllium, thallium, tin and vanadium were identified as uncertainties for further consideration. PCP was identified in both the SLERA and this analysis as a CoPEC for direct-pathway exposures; therefore, PCP is carried forward as a CoPEC for further consideration. The SLERA identified anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene benzo(k)fluoranthene, chrysene, indeno(1,2,3-c,d)pyrene, Total LPAHs, and Total HPAHs as CoPECs. This analysis carries those PAHs forward, and adds 2-methylnaphthalene, acenaphthene, acenaphthylene, benz(a)anthracene, fluorene, fluoranthene, pyrene, and Total PAHs as CoPECs posing potential direct-exposure risk to sensitive benthic invertebrates. Sediment sample stations are shown on Figure 3.

7.3 Surface Water CoPECs

To evaluate the ecological ramifications of the surface water data, ESVs were selected from available criterion and guidance documents. Analytes identified as CoPECs are those containing concentrations exceeding the selected ESVs. The following criterion

and guidance documents (Table 8) were evaluated and surface water ESVs were selected (Table 9), based preferentially on the most conservative benchmark. The available sediment screening values are limited to those benchmarks issued by:

- Canadian Water Quality Guidelines (CWQG) Surface Water Screening Benchmark (CCME 2003)
- EPA Freshwater Criterion Continuous Concentration (EPA 2002)
- EPA Region IV Surface Water Screening Benchmarks (EPA 2001c).
- EPA Region VI Fresh Water Surface Water Screening Benchmarks for aquatic biota (TNRCC 2001).
- National Ambient Water Quality Criteria (NAWQC) Surface Water Screening Benchmarks (EPA 2002).
- Tier II Secondary Value Surface Water Screening Benchmarks (Suter and Tsao 1996).

The recommended surface water ESVs selected (Table 9) represent the lowest or most conservative value available believed to represent thresholds below which adverse effects to sensitive invertebrates are improbable. The rationale used for the preferential selection of the most conservative benchmarks was identical to the ESV selection process for both soils and sediments, and emphasized a solid technical albeit hyper-conservative approach. Foremost considered were those benchmarks available for fresh water, and of those benchmarks, preferentially considered were those that are consensus-based and the most recently published in peer-reviewed scientific literature. However, significant data gaps in all criterion and guidance documents predicated that we use all ESVs to minimize uncertainties, again recognizing that several of the ESV values selected are hyper-conservative.

A summary of surface water COIs showing surface water station-specific COI concentrations are presented in Table 3. A summary of surface water COIs showing

frequency of detection as well as minimum and maximum concentrations detected are also presented in Table 9. Following comparison to direct and indirect ESVs, eight metals and six organic compounds were identified as CoPECs. The highest occurrences of these CoPECs were observed at sample station SW06, located approximately 4,900 feet upstream of the Wiggins facility northernmost boundary and within the City of Wiggins. We suspect that the source of the CoPECs at this sample station is likely sewage overflow from a sewage culvert situated within the Church House Branch channel, and although this channel is intermittent and usually dry, heavy precipitation resulting in severe surface water runoff would cause overflow of the culvert and downstream contamination of Church House Branch.

7.3.1 Inorganics

Of the eight identified metal CoPECs in Church House Branch surface waters, three metals (cadmium, silver, and zinc) were CoPECs found exclusively at station SW06 upstream of the Wiggins facility and within the City of Wiggins. The other five metal CoPECs (arsenic, barium, hexavalent chromium, copper, and lead) were found in samples collected within and/or downstream of the City of Wiggins; specifically, arsenic at station SW03, barium and hexavalent chromium at all stations, lead at all stations with the exception of station SW02, and copper at stations SW02, SW03, and SW04. Consequently, these CoPECs exceed their respective ESVs and may pose a risk to sensitive fresh water invertebrate species; however, only those CoPECs detected at sampling stations SW01 through SW03 can potentially be associated with facility operations.

7.3.2 Organic Compounds

In addition to the seven metals identified as CoPECs at SW06, two VOCs (chloroform, toluene), two SVOCs (benzyl alcohol and bis(2-ethylhexyl) phthalate), and cyanide were identified as CoPECs exclusively at station SW06. A chlorinated pesticide, 2,4,5-TP (silvex) was detected exclusively at station SW05; however, due to a lack of suitable

ESVs, this compound was relegated to an uncertainty and retained for further consideration.

7.3.3 Summary of Surface Water CoPECs

As with sediments (see preceding discussion), of relevance to the CMS are those surface water CoPECs that occur onsite (station SW03) and downstream of the Wiggins facility (stations SW01 and SW02). These CoPECs are five metals: arsenic (station SW03), barium (stations SW01 through SW03), hexavalent chromium (station SW01); copper (stations SW01 and SW02); and lead (stations SW01 and SW03). None of the aforementioned metals are associated with Wiggins facility operations; hence, the source of contamination is upstream and likely associated with the City of Wiggins sewage contamination. Surface water sample stations are shown in Figure 4.

8 Discussion

Using hyper-conservative benchmarks, this data collection and evaluation effort identified a number of soil, sediment, and surface water contaminants that may potentially pose a risk to ecological receptors and were retained as CoPECs which is an initial step in the ERA process. The sampling plan for this study involved collecting onsite samples and offsite samples both upstream and downstream of the Wiggins facility. The rationale for collecting onsite and downstream offsite samples is clear: to assess impacts potentially associated with facility operations. However, the rationale for collecting upstream offsite samples is less intuitive, but allowed us to assess possible background contamination not associated with Wiggins facility operations. In this section, the discussion will serve to identify and isolate CoPECs that may be related to facility operations from those that are clearly not. In doing so, we briefly discuss the potential risks posed by the CoPECs in an attempt to identify the most cost-effective mitigation solution.

8.1 Soils and Sediments

8.1.1 Soil CoPECs

Two inorganic COIs (arsenic and total chromium), one chlorinated phenol (PCP), ten individual PAH compounds (anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-c,d)pyrene, phenanthrene, and pyrene) and three PAH groups (Total PAHs, LPAHs, and HPAHs) were identified as soil CoPECs potentially posing direct-exposure risk to sensitive invertebrate species.

Of the CoPECs listed above, the only COI to exceed the selected soil ESV by three orders of magnitude was PCP (Table 5). Chromium, dibenz(a,h)anthracene, fluoranthene and pyrene exceeded selected soil ESVs by approximately two orders of magnitude, whereas arsenic, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-c,d)pyrene, phenanthrene, and TPAHs exceeded soil ESVs by a single order of magnitude or less (Table 5). Soil ESVs were not available for several individual PAHs (2-methylnaphthalene, acenaphthylene, benzo(g,h,i)perylene, chrysene) and two PAH groups (LPAHs, HPAHs); consequently, these COIs were identified as uncertainties and carried forward for potential further evaluation (see Table 5).

8.1.2 Sediment CoPECs

Sediment COIs that are relevant to the CMS are those which occur onsite (sample station SD05) and downstream of the Wiggins facility (sample stations SD01 through SD04). CoPECs at these sample stations not related to Wiggins facility operations include three metals (beryllium, thallium, and vanadium), two organic compounds (benzyl alcohol and 4-methylphenol), and cyanide. CoPECS at these sample stations potentially related to Wiggins facility operations include 12 individual PAH compounds (2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluorene, fluoranthene, and pyrene), three PAH groups (LPAHs, HPAHs, and Total PAHs), and PCP. All of the above-identified CoPECs may pose direct-exposure risk to sensitive benthic invertebrates.

Of the CoPECs listed above, benzyl alcohol and the PAHs 2-methylnaphthalene, acenaphthylene, anthracene, benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluorene, and naphthalene exceeded selected ESVs by a single order of magnitude or less; 4-methylphenol, certain individual PAHs (acenaphthene, fluoranthene, phenanthrene, and pyrene), LPAHs, HPAHs, and TPAHs exceeded selected sediment ESVs by two orders of magnitude (Table 7). Both cyanide

and PCP exceeded the selected sediment ESV by more than three orders of magnitude (Table 7). Sediment ESVs were not available for three metals (beryllium, thallium, vanadium) as well as five SVOCs (1-phenanthrenecarboxylic acid, 1,2,3,4,4, beta-sitosterol, ergosterol, hexadecane, hexadecanoic acid); consequently, these COIs were identified as uncertainties and carried forward for potential further evaluation (Table 7). As an additional note, several COIs (lead, mercury, tin) that were identified as either CoPECs or uncertainties are not included in the above list of CoPECs for further investigation because of their exclusive occurrence in sampling stations at least 4,900 ft upstream of Wiggins facility operations. As stated earlier, those CoPECs that are relevant to the CMS are those CoPECs that occur onsite (sample station SD05) and downstream of the Wiggins facility (sample stations SD01 through SD04).

8.1.3 Contaminant Fate in Soil and Sediment

SVOCs (PAHs and PCP) have a tendency to associate with organic matter via sorption, partitioning, or entrapment processes, particularly in areas like the soils and sediments found in the vicinity of the Wiggins facility, where the TOC concentrations are elevated. As a general rule, PAH persistence is proportional to the amount of natural organic matter in soil and sediments (Alexander 1999; Laor *et al* 1996; Weissenfels *et al* 1992; Morra 1996). Some authors have demonstrated that PAH-dissolved organic matter (DOM) complexes result in a decrease in PAH bioavailability to several aquatic invertebrate and vertebrate organisms; specifically, to amphipods, guppies, and bluegills (Freidig *et al* 1998; Landrum *et al* 1987; McCarthy and Jimenez 1985). However, the PAH-DOM complexes also result in decreased bioavailability to soil or sediment microorganisms (Bregnard *et al* 1998; Kelsey and Alexander 1997; White *et al* 1997) that would naturally biodegrade the contaminants, resulting in environmental persistence and the potential for persistent bioavailability. In contrast to these studies, work by Prevacek *et al* (2005) indicates that microbes influence PAHs directly or indirectly through pH and DOM alteration.

Bioavailability of the range of non-polar contaminants in sediments can be related to the fraction of contaminant rapidly desorbed (Cornelissen *et al* 2001; Kraaij *et al* 2002; Kraaij *et al* 2002; Lamoureux & Brownawell 1999). Cornelissen *et al* (2001) have demonstrated that contributions from slowly and very slowly desorbing fractions can contribute to bioaccumulation. Pignatello and Xing (1996) demonstrated that slowly desorbing fractions within sediments can persist for years, and Greenberg *et al* (2004) predicts fluorene persistence for years due to very slow desorption of an estimated 31–53 percent of bulk sediment concentrations, with bioavailable amounts (based on rapid desorption fractions) predicted between 31–55 percent of sediment concentration. Although van Noort *et al* (1999) found little to no uptake in biota of slowly and very desorbing fractions, Kukkonen *et al* (2003) showed that slowly desorbed fractions may contribute to organisms already in steady state.

Factors governing the desorption process and desorption kinetics are not completely understood; however, Karickhoff *et al* (1979) and Kan *et al* (1998) found that desorption rate constants are inversely proportional to the amount of organic matter in tested sediments, and Cornelissen *et al* (1999a) found no correlation between desorption kinetics and particle size (down to 1 μm in some cases) for PAHs, PCBs, and pesticides in sediments and soils, in contrast to a Ball and Roberts (1991) study that found contaminant desorption increases inversely proportional to particle size. Release kinetics may be due to significant heterogeneity among soil or sediment system particles: research by Talley *et al* 2002 and Ghosh *et al* 2003 demonstrate that soot-sorbed contaminants display significantly slower release kinetics than clay-, silt- or natural organic carbon-sorbed contaminants. In addition, there appear to be differences in release kinetics between surface-sorbed contaminants, which exhibit rapid-release kinetics, and pore-entrapped contaminants, which exhibit slower-release kinetics (Weber *et al* 1992; Xing & Pignatello 1997).

Given persistence of slow and very slow desorption fractions of semivolatiles concomitant with bioavailability lasting for years, the microbial degradation approach, a

natural pollution transformation process, is likely the only methodology with potential to completely remove subsurface water, sediment, and soil contaminants. Microbes of the genus *Pseudomonas* are the best-characterized degraders of aromatic compounds (Powlowski and Shingler 1990; Wackett 2003) and methanogenic consortia had the greatest effect on aqueous PAH solubility (Prevacek *et al* 2005). In cases where a suitable carbon source for methanogens is limited, as does not appear to be the case for sediments and soils in the study area, sulfate-reducing bacteria may have greater effect than methanogens (Prevacek *et al* 2005).

Bogan *et al* (2005) reports reduced mobility and diminished bioavailability of PAH contaminants to earthworms (*Eisenia fetida*) in soils containing large amounts of lampblack; thereby demonstrating a strong link between mobility and bioavailability of PAH components and the composition of an oil phase, with diesel-range rich hydrocarbon phases more mobile and bioavailable. These findings suggest that naphthalene may enhance mobility of other PAHs in soils, and HPAHs may not be bioavailable in soils containing no diesel-range fractions or other volatile hydrocarbons that decrease viscosity of oil phases in soil.

A recent study by Prevacek *et al* (2005) demonstrated that extractable aqueous-phase PAH concentrations increase under controlled anaerobic incubation; therefore, increasing PAH solubility under anaerobic conditions results in desorbed PAHs available for degradation and transformation processes under aerobic conditions. These findings have important implications for bioavailability of PAHs and PCP limited to drainage ditch outflows in areas that experience periodic inundation (anaerobic conditions) and drying cycles (aerobic conditions), and especially so if organic matter-associated PAHs migrate or can be induced to migrate to a location with sufficient oxygen and nutrients for biodegradation.

8.2 Surface Water

Of significance is that none of the surface water CoPECs exceeded the selected surface water ESV by more than one order of magnitude, and more importantly, that none of the aforementioned metals detected in surface water are associated with Wiggins facility operations. A number of COIs upstream of the Wiggins facility operations were found to be CoPECs. These contaminants include three metals (cadmium, silver, zinc), two SVOCs (benzyl alcohol, bis(2-ethylhexyl) phthalate), two VOCs (chloroform, toluene), one chlorinated pesticide (2,4,5-TP [Silvex]) and cyanide. Most if not all of these CoPECs are highly toxic to aquatic life; hence, the contaminant concentrations may have deleterious effects to both aquatic and terrestrial invertebrates and vertebrates. The sources of contamination to Church House Branch are likely numerous and varied, since the areas surrounding the stream, both upstream and downstream of the Wiggins property, range from residential to industrial land use, all of which are potential point and non-point sources of contamination. Contributors to surface water contamination appear to be upstream of the facility, and are likely associated with City of Wiggins sewage contamination, as evident in the latest sampling efforts at sediment sampling station SD10 (surface water sampling station SW06).

None of the surface water COIs elevating to CoPECs (barium, chromium, lead, and silver) are metals associated with Wiggins facility operations; hence, the source of contamination is upstream and likely associated with City of Wiggins sewage contamination. However, the potential for adverse ecological effects associated with Church House Branch surface water CoPECs appears high. For example, the potential toxicity of arsenic as arsenate replaces phosphate in oxidative phosphorylation of adenosine diphosphate (ADP) to adenosine triphosphate (ATP), thereby resulting in mitochondrial impairment, glycolytic metabolism pathway inhibition, and histopathological alterations. Hansen *et al* (2004) identified arsenic as causing observed growth inhibition in trout, in agreement with studies identifying liver and gall bladder as the probable target organs for critical arsenic bioaccumulation (Pedlar and Klaverkamp

2002; Pedlar *et al* 2002; Sorenson 1991). Riddell *et al* (2005) found that sublethal aqueous concentrations of cadmium resulted in significant behavioral effects in invertebrate species (caddisflies and mayflies) and trout, but also found evidence for species-specific cadmium tolerance. Hexavalent chromium is unstable in moderately oxidizing and reducing environments (DeLaune *et al* 1998; Masscheleyn *et al* 1992) and is also very soluble and highly toxic (DeLaune *et al* 1998; Barnhart 1997).

Compounding the analyses of surface water CoPECs is evidence that aqueous concentrations of CoPECs may not adequately assess the risk to aquatic organisms, as it is well documented that for some metals (silver, cadmium, copper, zinc), acute metal toxicity is much more reliably predicted at the site of toxic action (e.g., gill) by tissue residue concentration (TRC) than by water concentrations. Toll *et al* (2005) recommend that setting tissue residue-based water quality criteria may be appropriate for some of these substances.

Of potential concern is a partitioning of the sediment CoPECs to the surface water column. A number of pollutants, including PAHs, adversely effect living organisms by acting similarly to natural and synthetic hormones, causing endocrine system disruption (Lister and Van der Kraak 2001, Colburn *et al* 1996); however, the complete absence of detectable concentrations of PAHs and PCPs in Church House Branch surface water samples, including the only sample station (SW04) where these contaminants were identified as sediment CoPECs, likely indicates that ecological risk from PAHs and PCPs is non-existent to minimal. There are several reasons for this:

- the sorption, partitioning, and entrapment processes, as described in the discussion of sediments, tends to make PAHs and PCPs unavailable;
- in recognizing that the bioaccumulation process in aqueous sources is driven by desorption of contaminants from sediment particles (Cornelissen *et al* 2001; Kraaij *et al* 2001; Kraaij *et al* 2002; Lamoureux and Brownawell 1999; Hulscher *et al* 2003), the complete lack of detectable levels of PAHs and PCP in aqueous (surface water) samples suggests that the desorption kinetics of slow and very

slow fractions of sedimentary PAHs and PCP detected at SD06 (co-located with SW04) are minimal and therefore likely non-bioavailable;

- the absence of detectable levels of aqueous PAH and PCP contraindicates the existence of PAH-organic soluble complexes as identified by several studies (Burgess *et al* 1996; Gauthier *et al* 1987; Hwang *et al* 1998; Mitra & Dickhut 1999) that would result in unexpectedly high PAH concentrations in an aqueous phase media containing soluble natural organic matter;
- sufficient time has elapsed since the last release of site-related CoPECs that would be the source for PAH and PCP contamination, such that there may no longer be ecological risk from the sediment-sequestered PAHs and PCP, as studies by Landrum *et al* (1992) and Alexander (2000) showed that bioavailability, biodegradation and toxic effects decrease with increasing sediment particle-to-contaminant contact time, and at least a decade has passed since the last release, and;
- as bioaccumulation kinetics are governed by the rate of accumulation plus the rate of elimination, and research by Hwang *et al* (2004) indicating that elimination patterns of PAHs in eastern oysters are biphasic (faster elimination during early phase; much slower elimination subsequently), it appears that bioaccumulation risks through aqueous and sedimentary media are minimal or nonexistent.

Unlike PAHs and PCP, five sediment COIs identified at sediment sampling station SD01, relegated to uncertainties due to lack of available ESVs, have potential for adverse ecological effects if partitioning to the surface water column occurs. Three of the five CoPECs—hexadecanoic acid, beta-sitosterol and ergostanol—are natural or synthetic hormones causing endocrine system disruption. Hexadecanoic acid is a chemical communicant (behavior modifying chemical) common to several invertebrate insect and arachnid families and used as a pheromone, attractant, allomone, and kairomone, depending on the species. A close analogue of hexadecanoic acid (hexadecanoic acid, 2-sulfo-, 1-methylester, sodium salt) is found in detergent goods manufactured for clothing

(CERI 2000), indicating that the source of hexadecanoic acid is likely septic system contamination from surrounding residential land use. Beta-sitosterol is an endocrine disruptor affecting the reproductive systems of aquatic organisms and has been shown to decrease plasma sex steroid and cholesterol levels as well as *in vitro* gonadal steroid production in fish, resulting in delayed sexual maturity, gonadohypotrophy, and sterility (MacLatchy & Van der Kraak 1995). Beta-sitosterol is one of several plant sterols or phytosterols found in almost all plants, with beta-sitosterol-contamination a common constituent in pulp mill effluent as a by-product of the wood pulping process. Ergosterol is most commonly used as a biochemical index for living mass of fungi as it is the prevalent membrane sterol in most filamentous fungi and is nearly absent in other organisms of decomposition systems. The remaining two sediment CoPECs, hexadecane and 1-phenanthrenecarboxylic acid, are likely contributed to Church House Branch sediments from the plywood manufacturing facility (Hood Industries) immediately south and downstream of the Wiggins facility. Hexadecane is used by the paint manufacturing industry as a hydrocarbon solvent, and 1-phenanthrenecarboxylic has been identified as an organic compound constituent of plasticized polyvinyl chloride (PVC) toys (Stringer *et al* 2000). Gaps in regulatory coverage for both national ambient air quality and national water quality standards are recognized for all of the aforementioned CoPECs at SD01.

9 Conclusions

A review of the soil, sediment and surface water data indicates that the nature and extent of site-related chemicals in the forested woodland east of Church House Branch and within Church House Branch has been adequately characterized. Generally, the highest concentrations of COIs were observed in soil within the Wiggins facility boundaries in a limited area at the confluence of drainage ditches D1 and D2 (Figure 5). With respect to Church House Branch sediments, the highest concentrations of COIs were also observed in a limited area at station SD04, located at the easternmost International Paper property boundary (Figure 3). Lower concentrations of COIs were found outside the property boundaries in the northern and southeastern portions of the study area.

9.1 Summary of Soil CoPECs

Based on initial comparisons to ESVs, the following chemicals are considered soil CoPECs potentially posing direct-exposure risk to sensitive invertebrate species:

2-methylnaphthalene	chrysene
acenaphthylene	dibenz(a,h)anthracene
Anthracene	fluoranthene
Arsenic	indeno(1,2,3-c,d)pyrene,
benz(a)anthracene	phenanthrene
Benzo(a)pyrene	PCP
Benzo(b)fluoranthene	pyrene
Benzo(g,h,i)perylene	Total HPAHs
Benzo(k)fluoranthene	Total LPAHs
Chromium	Total PAHs

The only COIs to exceed the selected soil ESV by significant orders of magnitude (two to three orders) were PCP, chromium, dibenz(a,h)anthracene, fluoranthene, and pyrene (see Section 8). Soil ESVs were not available for several individual PAHs and two PAH

groups; consequently, these COIs were identified as uncertainties and could be carried forward for potential further evaluation.

As discussed earlier, it appears likely that drainage ditch soils, specifically those found in the forested land between the Wiggins facility and Church House Branch, may not pose a risk to ecoreceptors. This is contingent upon transport and phase transfer processes effectively reducing contaminants to harmless levels or sequestering contaminants, thereby reducing exposure to soil invertebrate species. Transport and phase transfer processes can also increase the reactivity of contaminants, thereby increasing rates of natural microbial degradation. As previously noted, only soil samples collected at the channelized, steep-walled confluence of ditches D1 and D2 contained concentrations of COIs exceeding the selected ESVs, such that the total area of contamination appears to be very small, on the order of approximately 30 square feet. Further, contaminants concentrated in those soils may migrate, through transport processes such as advection, dispersion, and diffusion, during periods of moderate to heavy precipitation, thereby reducing biological exposure to potentially toxic or harmful contaminant concentrations. In addition, SVOCs in soil that are not immediately biodegraded may not pose a significant risk to soil invertivore ecoreceptors, such as the short-tailed shrew (*Blarina brevicauda*), as studies by Matscheko *et al* (2002) indicate that low levels of PAHs probably do not persist in earthworm tissues and appear to be metabolized and excreted adequately.

9.2 Summary of Sediment CoPECs

Based on initial comparisons to ESVs, the following chemicals are considered sediment CoPECs potentially posing direct-exposure risk to sensitive invertebrate species:

1-phenanthrenecarboxylic acid, 1,2,3,4,4	Ergostanol
2-Methylnaphthalene	Fluoranthene
4-Methylphenol	Fluorene
Acenaphthene	Hexadecane
Acenaphthylene	Hexadecanoic acid
Anthracene	PCP
Benz(a)anthracene	Phenanthrene
Benzo(b)fluoranthene	Pyrene
Benzo(k)fluoranthene	Naphthalene
Beta-sitosterol	Total LPAHs
Benzyl Alcohol	Total HPAHs
Beryllium	Total PAHs
Chrysene	Thallium
Cyanide	Vanadium

The most significant sediment CoPECs were cyanide, the SVOCs 4-methylphenol and PCP, and several PAHs (acenaphthene fluoranthene, phenanthrene, pyrene, LPAHs, HPAHs, and TPAHs), which exceeded selected sediment ESVs by at least two orders of magnitude (see Section 8). Sediment ESVs were not available for three metals and five SVOCs; consequently, these COIs were identified as uncertainties and could be carried forward for further evaluation. As noted earlier, several COIs that were identified as either CoPECs or uncertainties (lead, mercury, tin) are not included in the above list of CoPECs for further investigation because of their exclusive occurrence in sampling stations at least 4,500 feet upstream of Wiggins facility operations; sediment CoPECs that are relevant to the CMS are those that occur onsite (station SD05) and downstream of the Wiggins facility (stations SD01 through SD04).

9.3 Summary of Surface Water CoPECs

As with sediments, of relevance to the CMS are those surface water CoPECs that occur onsite (station SW03) and downstream of the Wiggins facility (stations SW01 and SW02). Based on initial comparisons to ESVs, the following chemicals are considered surface water CoPECs potentially posing direct-exposure risk to sensitive invertebrate species:

Arsenic	Copper
Barium	Lead
Chromium (Hexavalent)	

None of the surface water CoPECs exceeded the selected surface water ESV by more than one order of magnitude.

It was suggested in the SLERA (Premier 2002) that insufficient quantities of PAHs and PCP are present in sediments to result in concentrations in the water column that would pose a threat to aquatic organisms, and this hypothesis appears to be supported by the most recent data presented herein. This latest research concurs with the suggestion in the SLERA and the conclusion of the earlier studies: that due to the conservatism inherent in the SLERA process through which the ESVs were selected and recognition of the affinity PCP and PAHs have for sorption to soil and sediments, it is highly unlikely that any of the identified CoPECs are of sufficient quantities in sediments to result in concentrations in the water column that would pose a threat to aquatic organisms or elicit adverse effects among wildlife receptors. This preliminary CMS further contends that the complete absence of detectable concentrations or significant concentrations of either PAHs or PCP in surface water samples suggests that these contaminants are not readily partitioning to the water column. If this is the case, and PAHs and PCP are sequestered in inaccessible microsites or covalently bond to the organic fraction of the soil or sediment particles, then overall bioavailability and toxicity decrease and hence these constituents will likely not pose a risk to ecoreceptors. However, if bioavailable, the

bioavailability appears limited to sediments and sediment-dwelling or sediment-ingesting organisms.

A number of COIs upstream of facility operations were found to be CoPECs. These contaminants include three metals (cadmium, silver, zinc), two SVOCs (benzyl alcohol, bis(2-ethylhexyl) phthalate), two VOCs (chloroform, toluene), one chlorinated pesticide (2,4,5-TP (Silvex)) and cyanide (Table 9). Most if not all of these CoPECs are highly toxic to aquatic life (see earlier discussion); hence, the contaminant concentrations may have deleterious effects to both aquatic and terrestrial invertebrates and vertebrates. The sources of contamination to Church House Branch are likely many and varied, as the areas surrounding the stream, both upstream and downstream of Wiggins property, range from residential to industrial land in use, all of which are potential point and non-point sources of contamination. Contributors to surface water contamination appear to be upstream of the facility, and are likely associated with the City of Wiggins sewage contamination, as evident in the latest sampling efforts at sediment sampling station SD10 (co-located with surface water sampling station SW06). It is likely that a significant risk to aquatic wildlife is the metal and organic compound contamination assumed to be associated with City of Wiggins and surrounding land use.

9.4 Recommendation

Having identified CoPECs as present in both the drainage ditch soils and Church House Branch sediments associated with the International Paper Wiggins facility operations completes the first step in assessing ecological effects. The final step in the ecological risk assessment process, identifying remedial actions, actually begins in the problem formulation step with solutions ranging from natural remediation (NR) to enhanced natural remediation (ENR) to active remediation (AR), or a combination of all three. In this section, the NR or “no action” alternative is recommended based on: 1) recognition that non-facility-associated contaminants in Church House Branch may pose equal or greater risk to ecological receptors of concern and ecological resources than

contamination due to facility-associated historical spills; 2) recognition that this latest data analysis suggests that contaminants within the sediment do not appear to desorb to the surface water column; 3) recognition that NR is documented as an effective method, as biotic reactions are the most important for contamination transformation; and 4) recognition that more highly valued ecological resources are likely to be protected by leaving the mature forest and wetlands of the site to remediate naturally.

NR is appropriate for situations where: 1) ecological resources are not under imminent threat from contaminants; 2) physical and chemical characteristics make contaminants amenable to NR; 3) ecosystem characteristics are amenable to NR (e.g., biodegrading flora or fauna are present and expected to persist); 4) protecting the ecosystem integrity is important; 5) time is sufficient for NR process; and 6) subsequent monitoring of NR results in data demonstrating reduction in ecological risks.

Based on these criteria, the Church House Branch portion of the Wiggins facility appears to qualify as a candidate for NR. First, sites where the extent of contamination can be shown to be very limited, as it is in both the soils of the drainage ditches and in the sediments of Church House Branch, are likely less of an immediate risk to vertebrate ecological receptors of concern. The foraging habitat of vertebrate predators (typically the ecological receptors of concern) can range from dozens of square meters to hundreds of hectares; consequently, the food contributions from very small contaminated areas can be negligible. In addition, ecological resources may not be under imminent threat from contaminants, as the physical and chemical properties of the International Paper Wiggins facility contaminants may make them non-bioavailable. Swartz and Di Toro (1997) demonstrated that organic materials in soils and sediments can attenuate both PAHs and petroleum hydrocarbons. Studies by Linz & Nakles (1996) and Kelsey & Alexander (1997) of PAH-containing soils indicate that PAHs become increasingly resistant to desorption with time—though poorly understood, the sequestering of hydrophobic organic compounds, such as PAHs and petroleum hydrocarbons, may be due to entrainment in soil micropores and partitioning into soil organic matter (Luthy *et al*

1997)—and therefore bioavailability to microorganisms and invertebrates decreases with time (Alexander 1995; Hatzinger & Alexander 1995; Kelsey & Alexander 1997). Since both soils and sediments onsite have high organic matter concentrations, sorption of contaminants to soil and sediment particles is likely, suggesting reduced bioavailability of contaminants to microorganisms and invertebrates. Recent arguments by several authors suggest that remediation of non-bioavailable contaminants is unwarranted and unnecessary as there is little to no human health or ecological benefit (Alexander 1995, Kelsey & Alexander 1997, Linz & Nakles 1997, NRC 2003).

Second, NR requires the presence of contaminants amenable to physical, chemical and biological transformation to non-toxic products. Pastorok *et al* (2000) qualifies NR as a viable option for sites with PAH and other petroleum hydrocarbon contamination originating from creosoting operations, based on oil spill research conducted by Neff (1987), Baker *et al* (1990) and Booth *et al* (1991). Preslo *et al* (1989) argue that NR is effective for soils containing contaminants amenable to dispersive processes and biodegradation, such as gasoline and other fuel oils, coal tar residues, and chlorinated solvents.

Third, the biotic and abiotic ecosystem characteristics must be amenable to NR. Environmental contaminants experience the effects of both biotic and abiotic processes in contaminant transformation. Abiotic processes are crucial to NR, as transport (advection, dispersion, sedimentation, diffusion) and phase transfer (oxidation/reduction, hydrolyses/photolysis, precipitation/dissolution, complexation) processes may reduce the biological exposure to deleterious contaminant concentrations down to harmless levels, or sequester contaminants, thereby reducing their exposure to organisms, or increase the reactivity of contaminants. In addition, phase transfer processes can enhance or retard the environmental transport of contaminants. Of these, oxidation, reduction, and hydrolysis reactions most reduce the risk associated with environmental contaminants, and are therefore the most important of the abiotic reactions. However, biotic reactions are recognized as more important than abiotic processes, and biotic transformations by

microorganisms (both bacteria and fungi) are recognized as the most important organisms contributing to the transformation of organic contaminants. For instance, white rot fungi can biodegrade several persistent environmental contaminants such as benzo(a)pyrene (Barr and Aust 1994) and other recalcitrant compounds with complex carbon skeletons similar to the lignin polymer (Bumpus *et al* 1985). Bleckmann *et al* (2000) stress the importance of quantifying the presence/absence and species of active microbial populations; such populations will be expected to persist in moist to aquatic environments, as liquid water is the only environmental prerequisite to microbial metabolic processes in soils (Stoltzky 1997). Given the locality of the Wiggins facility, moisture does not appear to be a limiting resource; however, the presence/absence of appropriate microbial species has yet to be deduced. Interestingly, the detection of ergosterol as a CoPEC in downstream sediments may indicate that the transformation of organic contaminants by microbes is occurring, as ergosterol content in river sediments is indicative of fungal activity and useful in assessing the biodegradation of pyrene (Ravelet *et al* 2001).

Fourth, the National Contingency Plan requires consideration of a “no action” or NR alternative to active remediation in consideration of total ecosystem values, particularly in cases like the Wiggins facility where highly valued ecological resources are involved. The highly valued ecological resources on the Wiggins facility site are two areas where CoPECs are an issue; specifically the mature forest habitat in which drainage ditches confluence, and the wetlands associated with Church House Branch. Equally important, the interface between the mature forest and wetland habitats represents another ecologically valued area warranting protection, as such “edge habitats” serve as a transition zone connecting the diversity of discrete habitats while increasing the functional integrity, biodiversity, and nutrient and energy dynamics of the entire ecosystem. NR is an important and viable option that is increasingly recognized as such because it addresses contamination without damaging ecosystems using active remediation techniques: Hawk and Karr (2003) argue that we must incorporate two dimensions of ecological risk into remediation: 1) stressors posing human and ecological

risk must be reduced; and 2) reductions in stressors should not result in new ecological risk from physical or other disruptions; e.g., active remediation (the “dig and haul” alternative) is as scientifically unacceptable as allowing sites to purge themselves by natural methods (the NR alternative) is often socially unacceptable. McLendon and Redente (1997) argue that our ability to develop and manage successful restoration projects is limited by our failure to recognize and utilize the effects of ecological factors and processes, such that we often times miss opportunities to accomplish remediation goals expediently and cost-effectively. MacMahon (1987) argues that increasing our ecological knowledge of site-specific processes increases effectiveness, increases ease of implementation, increases the likelihood of an action resulting in desirable results. Several researchers argue that NR can work as effectively as active cleanup and is less damaging, especially in shoreline or wetland habitats that are sensitive to physical disturbance, than invasive techniques (Johnson and Pastorok 1985; Baker *et al* 1990; Foster *et al* 1990; Booth *et al* 1991). The danger in risk management is that in scoping the objective too narrowly, such as reducing risk to macroinvertebrate receptors, cleanup actions may have adverse effects on the overall ecosystem. In fact, any adverse effects of cleanup activities are considered natural resource injuries under the National Resources Damages Act regulations, and may incur additional liabilities.

Based on the above arguments for NR and on recognition that non-facility-associated contaminants in Church House Branch may pose equal or greater risk to ecological receptors of concern than contamination due to facility-associated historical spills, that contaminants within the sediment do not appear to desorb to the surface water column, International Paper recommends “No Further Action” be taken, and that both soils and sediments be allowed to naturally remediate. The uncertainties inherent in suggesting the NR alternative at this early stage of the ERA process are: 1) immediacy of risk to ecological receptors has yet to be determined (in situations where the risk to ecological receptors is low to moderate, NR may be appropriate; however, in situations where the threat is immediate, corrective actions may be necessary to mitigate the threat); 2) appropriate cleanup levels for site-specific conditions without being under- or

overprotective of ecological resources have yet to be determined; and 3) the presence of appropriate microbial species for the specific contaminants has yet to be determined. We recognize that this recommendation may be premature in the ecological risk assessment process and that several conditions necessary for NR are as of yet unknown; however, we predict that the outcome will be the same, i.e., that the ultimate decision by risk managers will be to mitigate further degradation to the site-specific valued ecological resources by selecting the NR option.

10 References

- Alexander, M. 1995. How toxic are toxic chemicals in soil? *Environ Sci Technol* 29:2713-2717.
- Alexander M. 1999. *Biodegradation and Bioremediation*. Academic Press, New York NY.
- Alexander M. 2000. Aging, bioavailability, and overestimation of risk from environmental pollutants. *Environ Sci Technol* 34:4259-4265.
- ATK. 1991. RCRA facility assessment of International Paper Company Wiggins, Mississippi. Prepared for U.S. Environmental Protection Agency Region 4.
- Baker, JM, RB Clark, PF Kingston, RH Jenkins. 1990. Natural recovery of cold water environments after an oil spill. Presented at the Thirteenth Annual Arctic and Marine Oilspill Program Technical Seminar; June 1990
- Ball WP and PV Roberts. 1991. Long-term sorption of halogenated organic chemicals by aquifer material. 2. Intraparticle diffusion. *Environ Sci Technol* 25:1237-1249.
- Barnhart J. 1997. Chromium chemistry and implications for environmental fate and toxicity. *J soil Contam* 6:561-568.
- Barr, DP and SD Aust. 1994. Mechanisms white rot fungi use to degrade pollutants. *Environ Sci Technol* 28:79A-87A.
- Barth, D.S., and T.H. Starks. 1985. *Sediment Sampling Quality Assurance User's Guide* (EPA 600/4-85/048). U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Office of Research and Development, Las Vegas, NV.
- Bath and Wampler. 1984. Final report – geohydrologic impacts assessment hazardous waste management facilities, Treated Wood Products Plant, Wiggins, MS (not seen, as cited by Hopper 1988).
- Beyer, WN. 1990 Evaluation Soil Contamination. United States Fish and Wildlife Service, Biological Report 90(2).
- Bleckmann, CA, EC Heyse and MN Goltz. 2000. Natural remediation processes. In: Swindoll, M, RG Stahl, Jr. and SJ Ells, editors. Natural remediation of environmental

- contaminants: Its role in risk assessment and risk management. Pensacola FL: Society of Environmental Toxicology and Chemistry (SETAC) Press. 472 p.
- Bogan BW, KE Beardsley, WR Sullivan, TD Hayes and BK Soni. 2005. Effect of volatile hydrocarbon fractions on mobility and earthworm uptake of polycyclic aromatic hydrocarbons from soils and soil/lampblack mixtures. *Environ Toxicol Chem* 24:181-189.
- Booth, PN, DS Becker, RA Pastorok, JR Sampson, and WJ Graham. 1991. Evaluation of restoration alternatives for natural resources injured by oil spills. Health and Environmental Affairs Department. Washington DC: American Petroleum Institute. API Publication No 304.
- Bregnard TP-A, P Hohener and J Zeyer. 1998. Bioavailability and biodegradation of weathered diesel fuel in aquifer material under denitrifying conditions. *Environ Toxicol Chem* 17:1222-1229.
- Buchman, MF. 1999. NOAA Screening Quick Reference Tables. National Oceanic and Atmospheric Administration, Coastal Protection and Restoration Division, Seattle WA. NOAA HAZMAT Report 99-1. 12 p.
(<http://response.restoration.noaa.gov/cpr/sediment/squirt/squirt.html>)
- Bumpus, JA, M Tien, D Wright, SD Aust. 1985. Oxidation of persistent environmental pollutants by a white rot fungus. *Science*, 228: 1434-1436.
- Burgess RM, RA McKinney and WA Brown. 1996. Enrichment of marine sediment colloids with polychlorinated biphenyls: Trends resulting from PCB solubility and chlorination. *Environ Sci Technol* 30:2556-2566.
- CCME. 2003. Canadian Environmental Quality Guidelines: Summary of Existing Canadian Environmental Quality Guidelines. Canadian Council of Ministers of the Environment. Winnipeg, Manitoba.
(http://www.ccme.ca/publications/can_guidelines.html#184)
- CERI. 2000. Unpublished data. Report number K-1515. Chemicals Evaluation and Research Institute (CERI), Japan.
- Cornelissen G, H van Zuilen and PCM van Noort. 1999a. Particle size dependence of slow desorption of in situ PAHs from sediments. *Chemosphere* 38:2369-2380.
- Cornelissen G, H Rigterink, DEM ten Hulscher, BA Vrind and PCM van Noort. 2001. A simple Tenax® extraction method to determine the availability of sediment-sorbed organic compounds. *Environ Toxicol Chem* 20:706-711.

- Crommentuijn, T, DF Kalf, MD Polder, R Posthumus and EJ van de Plassche. 1997. Maximum permissible concentrations and negligible concentrations for metals, taking background concentrations into account. RIVM Report No 601501001.
- DeLaune RD, WH Patrick and T Guo. 1998. The redox-ph chemistry of chromium in water and sediment. In Allen HE, AW Garrison and GW Luther III, eds, *Metals in Surface Waters*. Chelsea, Ann Arbor MI, pp 241-255.
- DOE. 1993. Resource Conservation and Recovery Act Corrective Action Program Guide. U.S. Department of Energy.
- Efroymson, RA, ME Will and GW Suter. 1997a. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Processes: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge TN. ES/ER/TM-126/R2.
(<http://www.hrsd.ornl.gov/ecorisk/reports.html>)
- Efroymson, RA, ME Will, GW Suter and AC Wooten. 1997b. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge TN. ES/ER/TM-95/R4. (<http://www.hrsd.ornl.gov/ecorisk/reports.html>)
- EPA. 1986. Test methods for evaluating solid waste (SW-846). U.S. Environmental Protection Agency.
- EPA. 1988. Interim Final. Guidance for conducting remedial investigations and feasibility studies under CERCLA. U.S. Environmental Protection Agency.
- EPA. 1989. RCRA facility investigation guidance document. Volumes I-IV. EPA/SW-89/031. U.S. Environmental Protection Agency.
- EPA. 1993a. Great Lakes water quality initiative criteria documents for the protection of aquatic life in ambient water (draft). PB93-154656. National Technical Information Service, Springfield, VA. February 1993.
- EPA. 1996. Ecotox thresholds. ECO Update 3 (2):1-12
- EPA. 1993a. Notice of RCRA Hazardous and Solid Waste Amendment (HSWA) final permit decision. International Paper, Wiggins, Mississippi. EPA ID No. MSD 980 600 084. U.S. Environmental Protection Agency.
- EPA. 1994. Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. United States Environmental Protection Agency. Office of Solid Waste and Emergence Response. February 1994.
- EPA. 1995. Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment. United States Environmental Protection Agency, Region 4, Office of

- Technical Services. Atlanta, Georgia. Available online at:
www.epa.gov/region4/wastepgs/oftecser/ostguide.htm
- EPA Region IV. 1995. Ecological Risk Assessment Bulletin No. 2: Ecological Screening Values. US Environmental Protection Agency Region 4, Waste Management Division, Atlanta, GA. (superceded by
<http://www.epa.gov/region04/waste/ots/ecolbul.htm#tbl3>)
- EPA. 1996. Calculation and evaluation of sediment effect concentrations for the amphipod *Hyaella azteca* and the midge *Chironomus riparius*. US Environmental Protection Agency, Great Lakes National Program Office, Chicago IL. EPA 905/R96/008. (<http://www.cerc.usgs.gov/clearinghouse/data/brdcerc0004.html>)
(<http://www.cerc.usgs.gov/pubs/sedtox/sec-dev.html>)
- EPA. 1996. Environmental investigations, standard operating procedures and quality assurance manual. U.S. Environmental Protection Agency Region 4.
- EPA. 1997. *Field and Laboratory Methods for Macroinvertebrates and Habitat Assessment of Low Gradient Nontidal Streams*. US Environmental Protection Agency, Mid-Atlantic Coastal Streams Workgroup, Environmental Services Division, Region 3, Wheeling, WV.
- EPA. 1998. *Environmental Monitoring and Assessment Program-Surface Waters: Field Operations and Methods for Measuring the Ecological Condition of Wadeable Streams*, EPA/620/R-94/004F. US Environmental Protection Agency, Office of Research and Development, Research Triangle Park, NC.
- EPA. 1999a. Contract Laboratory Program National Functional Guidelines for Organic Data Review. U.S. Environmental Protection Agency Office of Emergency and Remedial Response. EPA540/R-99/008. October 1999.
- EPA. 1999b. *National Recommended Water Quality Criteria -- Correction*. United States Environmental Protection Agency, Office of Water. EPA 822-Z-99-001.
- EPA. 2004. RFI Approval International Paper Treated Wood Products Plant Wiggins Mississippi EPA ID Number MSD 9800 600 84 letter to Tom Richardson, International Paper, from Narindar M. Kumar, EPA. January 29, 2004.
- EPA. 2001a. Guidance on Environmental Data Verification and Validation, QA/G-8. Peer Review Draft, US Environmental Protection Agency, June 2001.
- EPA. 2001b. *Methods for Collection, Storage, and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual* (EPA-823-B-01-002). US Environmental Protection Agency, Washington, DC.

- EPA. 2001c. Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment. Originally published: EPA Region IV. 1995. US Environmental Protection Agency Region 4, Waste Management Division, Atlanta, GA. Website version last updated November 30, 2001:
<http://www.epa.gov/region4/waste/ots/ecolbul.htm>
- EPA. 2002. National Recommended Water Quality Criteria: 2002. US Environmental Protection Agency, Office of Water, Washington, DC. November 2002. EPA 822-R-02-047. (Available at (<http://www.epa.gov/ost/pc/revcom.pdf>.)
- EPA. 2003. Region 5 Ecological Screening Levels (ESLs, formerly EDQLs) for RCRA Appendix IX hazardous constituents, August 2003 revision. US Environmental Protection Agency Region V. (<http://www.epa.gov/reg5rcra/ca/ESL.pdf>)
- EPA. 2003. Final Guidance on Completion of Corrective Action Activities at RCRA Facilities. US Environmental Protection Agency.
- EPA. 2001. Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment. Originally published: EPA Region IV. 1995. US Environmental Protection Agency Region 4, Waste Management Division, Atlanta, GA. Website version last updated November 30, 2001:
<http://www.epa.gov/region4/waste/ots/ecolbul.htm>
- EPA. 2002. National Recommended Water Quality Criteria: 2002. US Environmental Protection Agency, Office of Water, Washington, DC. November 2002. EPA 822-R-02-047. (Available at (<http://www.epa.gov/ost/pc/revcom.pdf>.)
- EPA. 2003. Region 5 Ecological Screening Levels (ESLs, formerly EDQLs) for RCRA Appendix IX hazardous constituents, August 2003 revision. US Environmental Protection Agency Region V. (<http://www.epa.gov/reg5rcra/ca/ESL.pdf>)
- Exponent. 2000. RCRA Facility Investigation. Treated Wood Products Plant, Wiggins, Mississippi. Work Plan. Exponent, Bellevue, WA, 2000.
- Foster, MS, JA Tarpley and SL Dearn. 1990. To clean or not to clean: The rationale, methods, and consequences of removing oil from temperate shores. *Northwest Environ J* 6:105-120.
- Freidig AP, EA Garicano, FJM Busser and JLM Hermens. 1998. Estimating impact of humic acid on bioavailability and bioaccumulation of hydrophobic chemicals in guppies using kinetic solid-phase extraction. *Environ Toxicol Chem* 17:998-1004.
- Gauthier TD, WR Seltz and CL Grant. 1987. Effects of structural and compositional variation of dissolved humic materials on pyrene K_{OC} values. *Environ Sci Technol* 21:243-248.

- Ghosh U, JR Zimmerman and RG Luthy. 2003. PCB and PAH speciation among particle types in contaminated sediments and effects on PAH bioavailability. *Environ Sci Technol* 37:2209-2217.
- Gibson, G.R., M.L. Bowman, J. Gerritsen, and B.D. Snyder. 2000. *Estuarine and Coastal Marine Waters: Bioassessment and Biocriteria Technical Guidance* (EPA 822-B-00-024). U.S. Environmental Protection Agency, Office of Water, Washington, DC.
- Greenberg MS, GA Burton Jr, PF Landrum, MT Leppänen and JVK Kukkonen. 2005. Desorption kinetics of fluoranthene and trifluralin from Lake Huron and Lake Erie, USA, sediments. *Environ Toxicol Chem* 24:31-39.
- Hansen JA, J Lipton, PG Welsh, D Cacula and B MacConnell. 2004. Reduced growth of rainbow trout (*Oncorhynchus mykiss*) fed a live invertebrate diet pre-exposed to metal-contaminated sediments. *Environ Toxicol Chem* 23:1902-1911.
- Hatzinger, PB and M Alexander. 1995. Effect of aging of chemicals in soil on their biodegradability and extractability. *Environ Sci Technol* 29:537-545.
- Hauer, R.F., and G.A. Lamberti, Eds. 1996. *Methods in Stream Ecology*. Academic Press, San Diego.
- Hawke, MA and JR Karr. 2000. Ecological responses and compensatory mechanisms: Using ecological knowledge to improve remediation efforts. In: Swindoll, M, RG Stahl, Jr. and SJ Ells, editors. *Natural remediation of environmental contaminants: Its role in risk assessment and risk management*. Published by the Society of Environmental Toxicology and Chemistry (SETAC). p 31-56.
- Hwang B-G, K-S Jun, Y-D Lee and W-S Lung. 1998. Importance of DOC in sediments for contaminant transport modeling. *Water Sci Technol* 38:193-199.
- Johnson, TL and RA Pastorok. 1985. Oil spill cleanup: Options for minimizing adverse ecological impacts. Health and Environmental Sciences Department. Washington DC: American Petroleum Institute. API Publication No 4435
- Kan AT, G Fu, M Hunter, W Chen, CH Ward and MB Tomson. 1998. Irreversible sorption of neutral hydrocarbons to sediments: Experimental observations and model predictions. *Environ Sci Technol* 32:892-902.
- Karickhoff SW, DS Brown and TA Scott. 1979. Sorption of hydrophobic pollutants on natural sediments. *Water Res* 13:241-248.
- Kelsey, JW and M Alexander. 1997. Declining bioavailability and appropriate estimation of risk of persistent compounds. *Environ Toxicol Chem* 16:582-585.

- Kraaij RH, J Tolls, D Sijm, G Cornelissen, A Heikens and A Belfroid. 2002. Effects of contact time on the sequestration and bioavailability of different classes of hydrophobic organic chemicals to benthic oligochaetes (Tubificidae). *Environ Toxicol Chem* 21:752-759.
- Kraaij RH, S Ciarelli, J Tolls, BJ Kater, and A Belfroid. 2001. Bioavailability of lab-contaminated and native polycyclic aromatic hydrocarbons to the amphipod *Corophium volutator* relates to chemical desorption. *Environ Toxicol Chem* 20:1716-1724.
- Kukkonen, JVK, PF Landrum, S Mitra, DC Gossiaux, J Gunnarsson and D Weston. 2003. Sediment characteristics affecting desorption kinetics of select PAH and PCB congeners for seven laboratory spiked sediments. *Environ Sci Technol* 37:4656-4663.
- Lamoureux EM and BJ Brownawell. 1999. Chemical and biological availability of sediment-sorbed hydrophobic organic contaminants. *Environ Toxicol Chem* 18:1733-1714.
- Landrum PF, BJ Eadie and WR Faust. 1992. Variation in the bioavailability of polycyclic aromatic hydrocarbons to the amphipod *Diporeia* (spp.) with sediment aging. *Environ Toxicol Chem* 11:1197-1208.
- Landrum PF, SR Nihart, BJ Eadie and LR Herche. 1987. Reduction in bioavailability of organic contaminants to the amphipod *Pontoporeia hoyi* by dissolved organic matter of sediment interstitial waters. *Environ Toxicol Chem* 6:11-20.
- Laor Y, PF Strom and WJ Farmer. 1996. The effect of sorption on phenanthrene bioavailability. *J Biotechnol* 51:227-234.
- LET. 1984. Geohydrologic impact assessment of the hazardous waste management facility Prepared for International Paper Company. Law Engineering and Testing Company.
- Linz, DG and DV Nakles. 1996. Environmentally acceptable endpoints in soil: Risk-based approach to contaminated sited management based on availability of chemicals in soil. American Academy of Environmental Engineers. ISBN 1883767 14.
- Lister AL and GJ Van der Kraak. 2001. Endocrine disruption: Why is it so complicated? *Water Qual Res J Can* 36:175-190.
- Luthy, RG, GR Aiken, ML Brusseau, SD Cunningham, PM Gschwend, JJ Pignatello, M Reinhard, SJ Traina, WJ Weber and JC Westall. 1997. Sequestration of hydrophobic organic contaminants by geosorbents. *Environ Sci Technol* 31(12):3341-3347.

- MacDonald, DD, C Ingersoll and TA Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. *Arch Environ Contam Toxicol* 39: 20-31.
- MacMahon, JA. 1987. Disturbed lands and ecological theory: An essay about a mutualistic association. In: Jordan III, WR, ME Gilpin and JD Aber, editors. *Restoration ecology: A synthetic approach to ecological research*. New York NY: Cambridge University Press. p. 221-227.
- MacLachy, DL and GJ Van der Kraak. 1995. The phytoestrogen beta-sitosterol alters the reproductive endocrine status of goldfish. *Tox App Pharm* 134: 305-312
- Massecheleyn PH, JH Pardue, RD DeLaune and WH Patrick. 1992. Chromium redox chemistry in a lower Mississippi valley bottomland hardwood wetland. *Environ Sci Technol* 26:1217-1226.
- Matscheko N, S Lundstedt, L Svennson, M Harju and M Tysklind. 2002. Accumulation and elimination of 16 polycyclic aromatic compounds in the earthworm (*Eisenia fetida*). *Environ Toxicol Chem* 21:1724-1729.
- McCarthy JF and BD Jimenez. 1985. Reduction in bioavailability to bluegills of polycyclic aromatic hydrocarbons bound to dissolved humic material. *Environ Toxicol Chem* 4:511-521.
- McLendon, T. and EF Redente. 1997. Revegetation manual for the environmental restoration contractor. Richland WA: Bechtel Hanford. BHI-00971 Rev.0.
- MDEQ. 1995. Water quality criteria for intrastate, interstate and coastal waters. Mississippi Department of Environmental Quality. November 1995.
- MHSPE. 1994. Circular on target values and intervention values for soil remediation and Annex A: Target Values, Soil Remediation Intervention Values and Indicative Levels for Serious Contamination. Netherlands Ministry of Housing, Spatial Planning and Environment. (<http://www.minvrom.nl/minvrom/docs/bodem/annexS&I2000.PDF>)
- Mitra S and RM Dickhut. 1999. Three-phase modeling of polycyclic aromatic hydrocarbon association with pore-water-dissolved organic carbon. *Environ Toxicol Chem* 18:1144-1148.
- Morra MJ. 1996. Bioremediation in soil: Influence of soil properties on organic contaminants and bacteria. In Crawford RL and DL Crawford, eds, *Bioremediation: Principles and Applications*. Cambridge University Press, Cambridge UK, pp 35-60.
- National Research Council (NRC). 2003. *Bioavailability of Contaminants in Soils and Sediments: Process, Tools, and Applications*. National Academics, Washington DC.

- Neff, JM. 1987. Biological effects of oil in the marine environment. Chem Eng Prog, November: 27-330
- NOAA. 1999. Sediment Quality Guidelines developed for the National Trends Status and Trends Program. National Oceanic and Atmospheric Administration, National Ocean Service, Office of Response and Restoration.
(<http://response.restoration.noaa.gov/cpr/sediment/SPQ.pdf>)
- OSWER. 1996. Ecotox Thresholds. US Environmental Protection Agency, Office of Solid Waste and Emergency Response. ECO Update 3(2): 1-12.
(http://www.epa.gov/superfund/programs/risk/eco_updt.pdf)
- Pastorok, RA, C Noftsker, TJ Iannuzzi, DF Ludwig, RC Barrick, MV Ruby and DF Bodishbaugh. 2000. Natural remediation of polynuclear aromatic hydrocarbons and other petroleum hydrocarbons. In: Swindoll, M, RG Stahl, Jr. and SJ Ells, editors. Natural remediation of environmental contaminants: Its role in risk assessment and risk management. p. 159-198.
- Pedlar RM and JF Klaverkamp. 2002. Accumulation and distribution of dietary arsenic in lake whitefish (*Coregonus clupeaformis*). *Aquat Toxicol* 57:33-166.
- Pedlar RM, MD Ptashynski, R Evans and JF Klaverkamp. 2002. Toxicological effects of dietary arsenic exposure in lake whitefish (*Coregonus clupeaformis*). *Aquat Toxicol* 57:167-189.
- Persaud, D, R Jaagumagi, and A Hayton. 1993. Guidelines for the protection and management of aquatic sediment quality in Ontario. Ontario Ministry of the Environment and Energy, Ottawa, Ontario. ISBN 0-7729-9248-7. 23p.
(http://www.ene.gov.on.ca/envision/gp/B1_3.pdf)
- Pignatello JJ and B Xing. 1996. Mechanisms of slow of sorption of organic chemicals to natural particles. *Environ Sci Technol* 30:1-11.
- Powlowski J and V Shingler. 1990. In vitro analysis of polypeptide requirements of multicomponent phenol hydroxylase from *Pseudomonas* sp. strain CF600. *J Bacteriol* 172:6834-6840.
- Premier. 2002. RCRA Facility Investigation. Treated Wood Products Plant, Wiggins, Mississippi. Report. Premier, Venice, CA, 2002.
- Premier. 2004. Corrective Measures Study Work Plan. International Paper Company, Treated Wood Products Plant, Wiggins, Mississippi. Report. Premier, Seattle, WA, 2004.
- Preslo, L, M Miller, M McLearn, W Suyama, P Kostecki and E Fleische. 1989. Available remedial technologies for petroleum contaminated soils. In: Bonazountas,

- M, DM Hetrick, PT Kostecki, EJ Calabrese, editors. SESOIL in environmental fate and risk modeling. Amherst MA: Amherst Scientific
- Prevacek TL, RF Christman, and FK Pfaender. 2005. Impact of imposed anaerobic conditions and microbial activity on aqueous-phase solubility of polycyclic aromatic hydrocarbons from soil. *Environ Toxicol Chem* 24:286-293.
- [Ravelet, C, C Grosset and J. Alary. 2001. Quantization of ergosterol in river sediment by liquid chromatography: Journal of Chromatographic Science 39\(6\): 239-242.](#)
- Riddell DJ, JM Culp and DJ Baird. 2005. Behavioral responses to sublethal cadmium exposure within an experimental aquatic food web. *Environ Toxicol Chem* 24:431-441.
- Roland, V. 2000. Personal communication (telephone conversation with L. Brewer, Exponent, Los Angeles, CA, on July 9, 2000). International Paper Wiggins, Mississippi Treated Wood Products Plant.
- Sorensen EM. 1991. *Metal Poisoning in Fish*. CRC Press, Boca Raton FL.
- Stoltzky, G. 1997. Soil as an environment for microbial life. In: van Elsas, JD, JT Trevors and EMH Wellington, editors. *Modern soil microbiology*. New York NY: Marcel Dekker. p1-20
- Stringer, R, I Labunska, D Santillo, P Johnston, J Siddorn and A Stephenson. 2000. Concentrations of phthalate esters and identification of other additives in PVC children's toys. *Environ Sci & Pollut Res* (7): 1-10.
- Suter, GW, II, and CL Tsao. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. 104pp. ES/ER/TM-96/R2.
(<http://www.esd.ornl.gov/programs/ecorisk/documents/tm96r2.pdf>.)
- Swartz, RC and MD Di Toro. 1997. Sediments as complex mixtures: An overview of the methods to assess ecotoxicological significance. In: Ingersoll, CG, T Dillon, GR Biddinger, editors. *Ecological Risk Assessment of Contaminated Sediments*. Pensacola FL: Society of Environmental Toxicology and Chemistry (SETAC).
- TNRCC. 2001. Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas. Texas Natural Resource Conservation Commission, Toxicology and Risk Assessment Section, Austin, TX. RG-263 (revised).
- Toll JE, LM Tear, DK DeForest, KV Brix and WJ Adams. 2005. Setting site-specific water-quality standards by using tissue residue criteria and bioaccumulation data. Part 1. Methodology. *Environ Toxicol Chem* 24:224-230.

- URS. 1999. Semiannual groundwater monitoring report, second and third quarters, 1999. International Paper, Baton Rouge, LA. Prepared by URS Greiner Woodward Clyde.
- USGS. 1983. White's Crossing and Wiggins, Mississippi quadrangles, 7.5-minute series. U.S. Geological Survey.
- van Noort PCM, G Cornelissen and D ten Hulscher. 1999. Sediment quality criteria, bioavailability, and sorptive attenuation of organic compounds. *Society of Environmental Toxicology and Chemistry (SETAC) – Europe News* 10:16-17.
- Wackett LP. 2003. *Pseudomonas putida* - a versatile biocatalyst. *Nat Biotechnol* 21:136-138.
- Weissenfels WD, HJ Klewer and J Langhoff. 1992. Adsorption of polycyclic aromatic hydrocarbons (PAHs) by soil particles: Influence on biodegradability and biotoxicity. *Appl Microbiol Biotechnol* 36:689-696.
- Weber WJ Jr, PM McGinley and LE Katz. 1992. A distributed reactivity model for sorption by soils and sediments. 1. Conceptual basis and equilibrium assessments. *Environ Sci Technol* 26:1955-1962.
- Wetzel, R.G. and G.E. Likens. 2000. *Limnological Analysis, 3rd Edition*. Springer, NY.
- WHE. 1997. Confirmatory sampling and structural integrity testing results for solid waste management units and areas of concern. Walk Haydel Environmental, New Orleans, LA.
- WHE. 1998. RCRA facility investigation work plan. Prepared for International Paper Company, Wiggins, MS. Walk Haydel Environmental, Baton Rouge, LA.

Figures

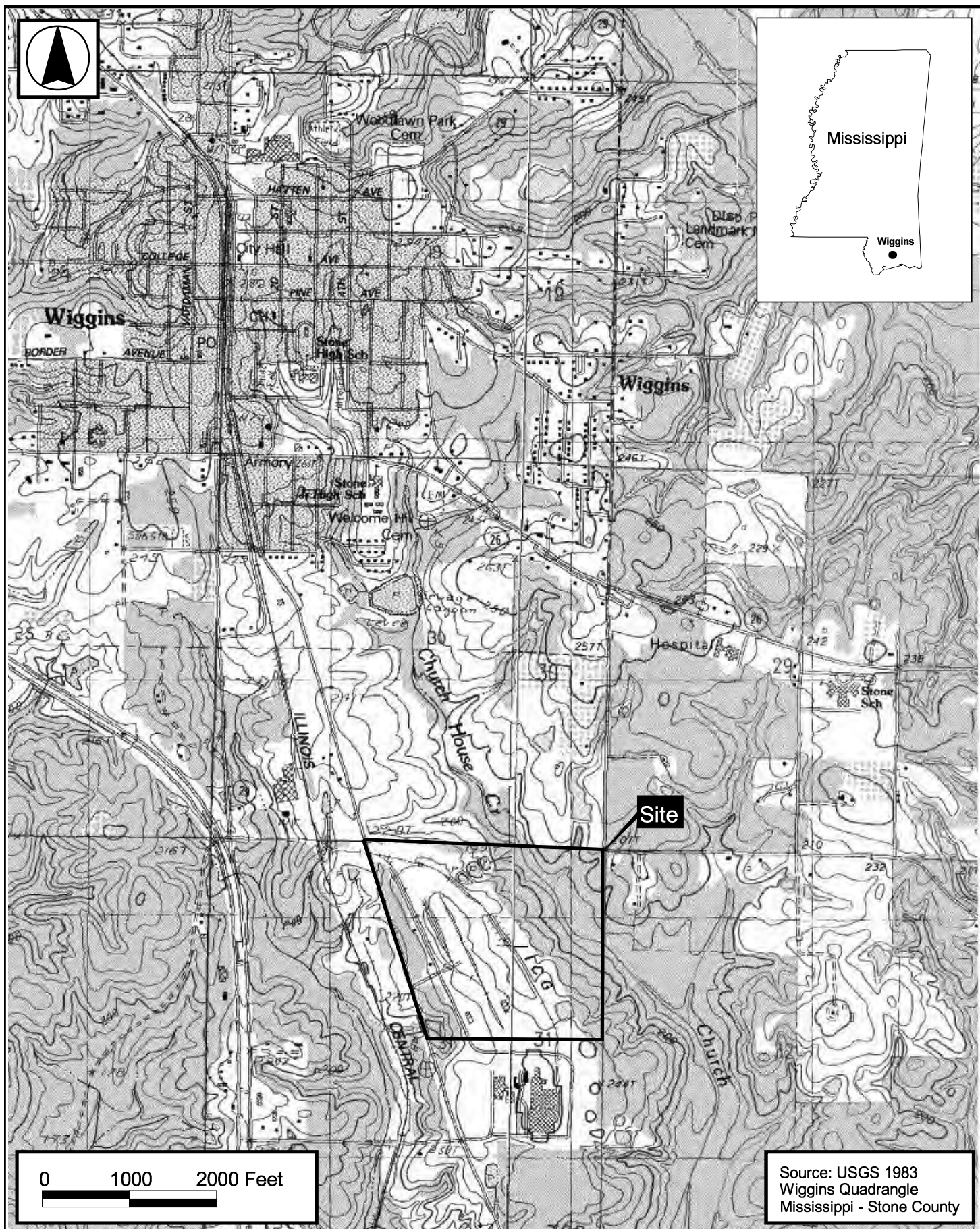


Figure 1. Wiggins Treated Wood Products Plant site location map

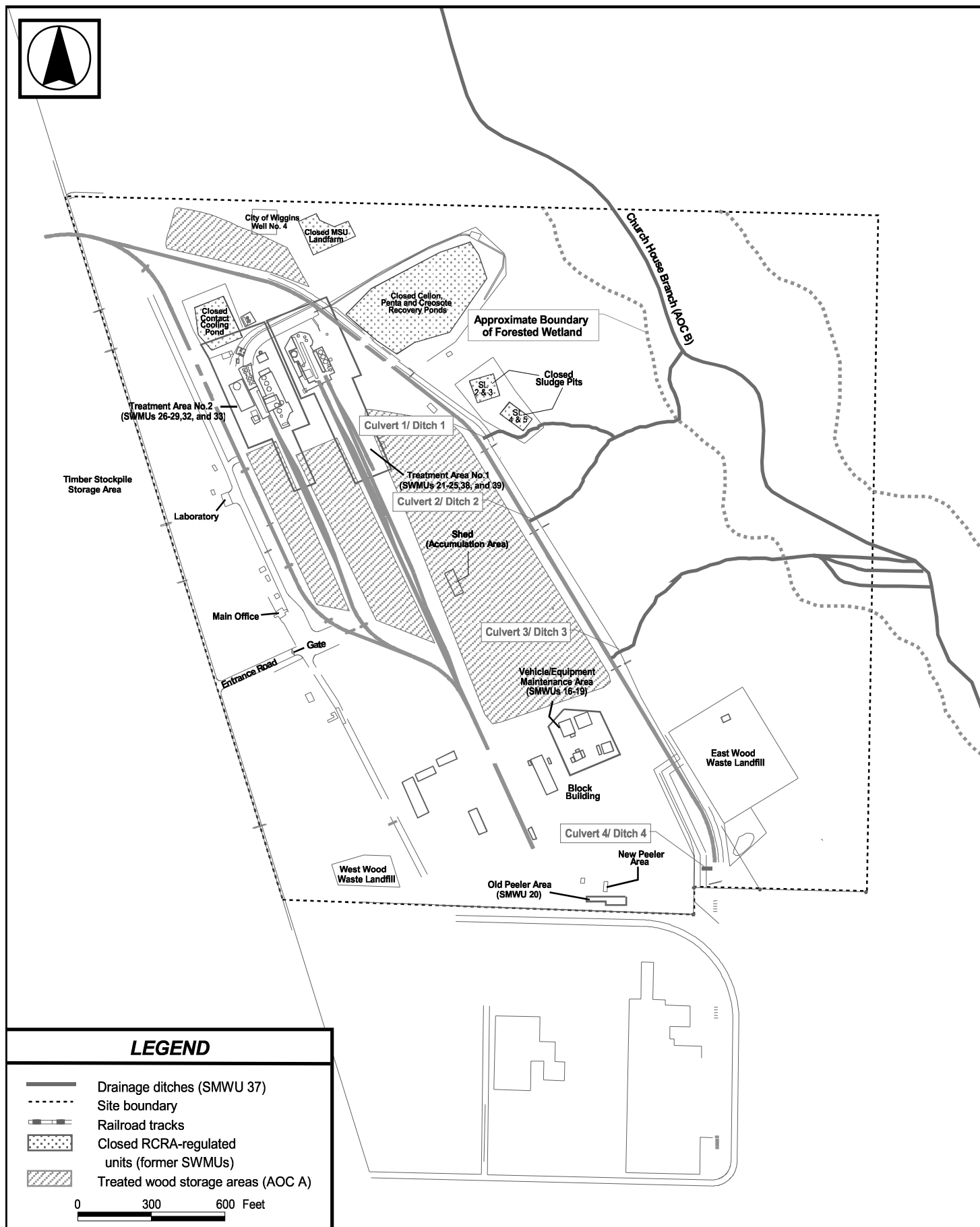


Figure 2. Wiggins facility CMS SWMUs and AOC locations



Figure 3. Sediment Sampling Locations



Figure 4. Surface Water Sampling Locations

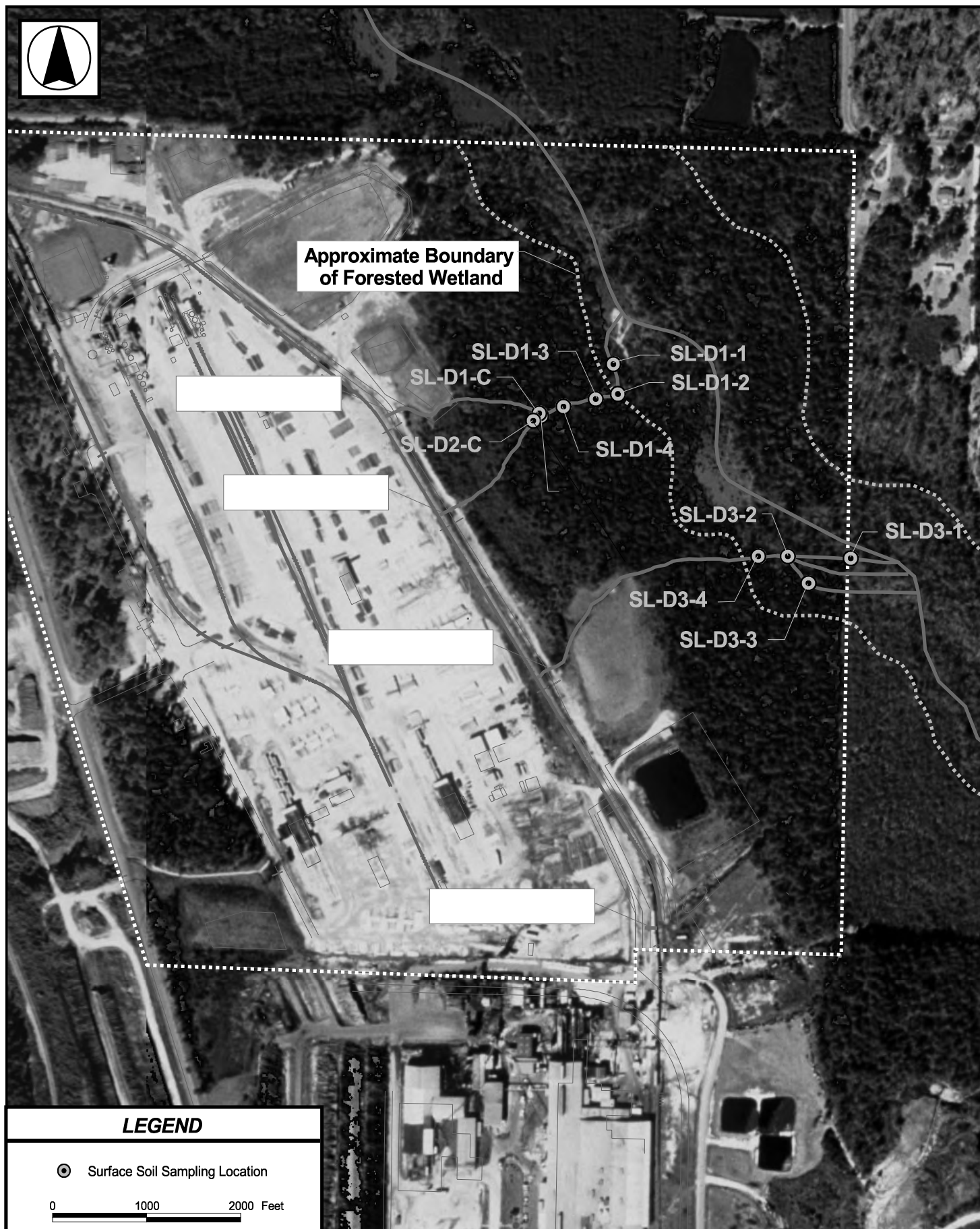


Figure 5. Surface Soil Sampling Locations

Tables

Table 1. Constituents of Interest -- Soil.

Station		D1-1	D1-2	D1-3	D1-4	D3-1	D3-2	D3-3	D3-4	D1-C	D2-C	D2-C	D1/D2-C
Sample		SD5001	SD5002	SD5003	SD5004	SD5005	SD5006	SD5007	SD5008	SD5009	SD5010	SD5011	SD5012
Date		10/13/04	10/13/04	10/13/04	10/13/04	10/13/04	10/13/04	10/13/04	10/13/04	10/13/04	10/13/04	10/13/04	10/13/04
Depth		0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In
Analyte	Units											Field dup	
Metals													
Arsenic, Total	mg/Kg	28.6	17.6	12.6	14.4	8.45	2.16	8.16	4.32	23.9	18.7	18	28.8
Chromium, Total	mg/Kg	37.8	27.9	23.6	19.1	14.7	4.05	15.3	8.17	65.8	47.4	36.5	49.2
Semivolatile organic compounds													
Pentachlorophenol (PCP)	ug/Kg	0.46 U	0.45 U	0.44 U	0.48 U	0.52 U	0.48 U	0.51 U	0.48 U	0.46 U	5400 J	110 J	230
Polycyclic aromatic hydrocarbons													
2-Methylnaphthalene	ug/Kg	0.73 U	0.71 U	0.69 U	0.75 U	0.82 U	0.75 U	0.8 U	0.76 U	0.72 U	0.72 U	0.72 U	1.5 J
Acenaphthene	ug/Kg	1.2 U	1.7 J	1.1 U	1.2 U	1.3 U	1.2 U	1.3 U	1.2 U	1.2 U	19	1.2 U	1.4 J
Acenaphthylene	ug/Kg	0.76 U	0.74 U	0.72 U	0.79 U	0.86 U	0.78 U	0.84 U	0.79 U	0.76 U	90 J	3.7 J	26
Anthracene	ug/Kg	0.8 J	8.3	0.73 U	0.94 J	3.2 J	1.7 J	1.5 J	0.8 U	1.5 J	280 J	7.9 J	88
Fluorene	ug/Kg	0.69 U	1.8 J	0.66 U	0.72 U	0.78 U	0.71 U	0.76 U	0.72 U	0.69 U	62	0.69 U	3.6 J
Naphthalene	ug/Kg	0.58 U	0.57 U	0.55 U	0.6 U	0.65 U	0.59 U	0.63 U	0.6 U	0.57 U	0.58 U	0.57 U	1.6 J
Phenanthrene	ug/Kg	3.5 J	28	2.4 J	4 J	13	6	5.5	3.6 J	6.1	4400 J	7.5 J	27
LPAH	ug/Kg	6.28	40.81	4.625	6.575	17.975	9.325	8.745	6.035	9.19	4851.65	20.69	149.1
Benz(a)anthracene	ug/Kg	5.8	37	4.4	7.6	19	11	11	6.1	8.6	3300 J	22 J	200
Benzo(a)pyrene	ug/Kg	1.8 U	24	1.7 U	2.8 J	11	7.9	5.7	1.8 U	4	1000 J	13 J	120
Benzo(b)fluoranthene	ug/Kg	4.8	41	3.3 J	7.4	21	15	12	5.5	10	4600 J	54 J	440
Benzo(g,h,i)perylene	ug/Kg	4.6	18	3.6 J	5.8	12	8.9	8.2	4.4	6.9	430 J	11 J	68
Chrysene	ug/Kg	5.1	31	3.8	6.6	16	10	9.3	5.4	8.1	4300 J	34 J	440
Fluoranthene	ug/Kg	9	69	7	13	35	22	18	10	16	20000 J	41 J	290
Indeno(1,2,3-cd)pyrene	ug/Kg	5.8	22	4.7	7.3	14	11	10	5.8	8.3	670 J	16 J	95
Pyrene	ug/Kg	8.1	54	6	11	28	17	15	8.4	14	14000 J	46 J	320
Benzo(k)fluoranthene	ug/Kg	2.1 U	8.2	2 U	2.2 U	2.4 U	2.2 U	2.3 U	2.2 U	2.1 U	680 J	17 J	150
Dibenz(a,h)anthracene	ug/Kg	2.3 U	2.3 U	2.2 U	2.4 U	2.6 U	2.4 U	2.6 U	2.4 U	2.3 U	200	2.3 U	21
HPAH	ug/Kg	46.3	305.35	35.75	63.8	158.5	105.1	91.65	48.8	78.1	49180	255.15	2144
Total PAH	ug/Kg	52.58	346.16	40.38	70.38	176.48	114.43	100.40	54.84	87.29	54031.65	275.84	2293.1

Notes:

U - not detected at detection limit shown

J - estimated

In - Inch

LPAH - low molecular weight polycyclic aromatic hydrocarbon

HPAH - high molecular weight polycyclic aromatic hydrocarbon

Table 2. Constituents of Interest -- Sediment.

Station		SD-01	SD-02	SD-03	SD-03	SD-04	SD-05
Sample		SD6001	SD6002	SD6003	SD6011	SD6004	SD6005
Date		10/14/04	10/18/04	10/18/04	10/18/04	10/18/04	10/18/04
Depth		0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In
Analyte	Units				Field dup		
Metals							
Antimony, Total	mg/Kg	0.109 B	0.09 U	0.08 U	0.109 U	0.117 U	0.084 U
Arsenic, Total	mg/Kg	0.664	0.269 U	1.1	1.34	2.94	0.84
Barium, Total	mg/Kg	43.4	35.5	22	21.9	44.3	19.9
Beryllium, Total	mg/Kg	0.421 B	0.345 B	0.245 U	0.27 U	0.341 B	0.257 U
Chromium, Total	mg/Kg	12.2	6.26	6.67	6.71	15	4.47
Cobalt, Total	mg/Kg	2.59	1.39	0.839	0.843	2.1	0.58 B
Copper, Total	mg/Kg	2.76	1.68	3.49	3.95	8.41	2.23
Lead, Total	mg/Kg	10.1	6.53	6.83	7.95	13.1	9.28
Mercury, Total	mg/Kg		0.05 B	0.027 B	0.031 B	0.063 B	0.039 B
Nickel, Total	mg/Kg	3.95	2.3	1.98	1.96	6.53	1.4
Silver, Total	mg/Kg	0.085 U	0.045 B	0.03 B	0.033 B	0.063 B	0.035 B
Thallium, Total	mg/Kg	0.301 B	0.2 U	0.076 U	0.072 U	0.153 U	0.082 U
Tin, Total	mg/Kg	1.82 U	1.44 U	1.44 U	1.49 U	1.79 U	1.01 U
Vanadium, Total	mg/Kg	25	8.55	10.4	11.3	30	7.9
Zinc, Total	mg/Kg	10.7	6.5 B	11.8	13.7	24.4	7.64
Semivolatile organic compounds							
Pentachlorophenol (PCP)	ug/Kg	25 J	36 U	84 J	35 U	1500	260 J
4-Methylphenol	ug/Kg	34 U	40 U	37 U	40 U	180 J	53 J
Benzyl alcohol	ug/Kg	28 U	34 U	31 U	34 U	62 J	32 U
Bis(2-ethylhexyl) phthalate	ug/Kg	21 U	25 U	56 J	66 J	70 J	23 U
Dibenzofuran	ug/Kg	17 U	20 U	19 U	20 U	270	19 U
Hexadecanoic acid	ug/Kg	320 NJ	--	--	--	--	--
1-Phenanthrenecarboxylic acid, 1,2,3,4	ug/Kg	390 NJ	--	--	--	--	--
Hexadecane	ug/Kg	460 NJ	--	--	--	--	--
Beta-sitosterol	ug/Kg	960 NJ	--	--	--	--	--
Ergosterol	ug/Kg	540 NJ	--	--	--	--	--
Polycyclic aromatic hydrocarbons							
2-Methylnaphthalene	ug/Kg	20 U	23 U	22 U	23 U	30 J	22 U
Acenaphthene	ug/Kg	25 U	30 U	27 U	29 U	400	28 U
Acenaphthylene	ug/Kg	25 U	30 U	27 U	29 U	54 J	28 U
Anthracene	ug/Kg	1.5 J	17 U	16 U	17 U	420	16 U
Fluorene	ug/Kg	13 U	16 U	15 U	16 U	470	15 U
Naphthalene	ug/Kg	17 U	20 U	19 U	20 U	29 J	19 U
Phenanthrene	ug/Kg	4 J	20 U	32 J	30 J	1300	19 U

LPAH	ug/Kg	55.5	78	95	97	2703	73.5
Benz(a)anthracene	ug/Kg	14 U	17 U	16 U	17 U	830	16 U
Benzo(a)pyrene	ug/Kg	25 U	30 U	27 U	290 U	350 U	28 U
Benzo(b)fluoranthene	ug/Kg	26 U	31 U	29 U	310 U	400 J	29 U
Benzo(g,h,i)perylene	ug/Kg	21 U	25 U	23 U	250 U	300 U	23 U
Benzo(k)fluoranthene	ug/Kg	21 U	25 U	23 U	250 U	430 J	23 U
Chrysene	ug/Kg	28 U	34 U	31 U	34 U	960	32 U
Fluoranthene	ug/Kg	3.9 J	19 U	80 J	73 J	4900	18 J
Pyrene	ug/Kg	6.2 J	22 U	42 J	45 J	2500	21 U
Dibenz(a,h)anthracene	ug/Kg	28 U	34 U	31 U	340 U	410 U	32 U
Indeno(1,2,3-cd)pyrene	ug/Kg	23 U	28 U	26 U	280 U	330 U	26 U
HPAH	ug/Kg	103.1	132.5	225	1003.5	10715	133
Total PAH	ug/Kg	158.6	210.5	320	1100.5	13418	206.5
<i>Volatile organic compounds</i>							
2-Butanone (MEK)	ug/Kg	1.5 U	1.7 U	6.3 J	4.2 J	5.8 J	1.6 U
Acetone	ug/Kg	3.3 U	11 J	40 J	29 J	42 J	14 J
Toluene	ug/Kg	0.073 U	0.085 U	29 J	5.4 J	0.65 J	0.08 U
<i>Other constituents</i>							
Cyanide, Total	mg/Kg	0.12	0.21 J	0.17	0.16	0.21	0.17

Notes:

U - not detected at detection limit shown

UJ - estimated detection limit

J - estimated

B (metals) - estimated

NJ - the analyte is tentatively identified and the result is an estimate

* - Result from Method 8270C selected ion monitoring (SIM) analysis

LPAH - low molecular weight polycyclic aromatic hydrocarbon

HPAH - high molecular weight polycyclic aromatic hydrocarbon

PAH - Polycyclic aromatic hydrocarbon

Table 2. Constituents of Interest -- Sediment (continued)

Station		SD-06	SD-07	SD-08	SD-09	SD-10
Sample		SD6006	SD6007	SD6008	SD6009	SD6010
Date		10/18/04	10/18/04	10/19/04	10/19/04	10/19/04
Depth		0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In
Analyte	Units					
Metals						
Antimony, Total	mg/Kg	0.343 U	0.593 U	0.608 B	0.345 J	0.591 B
Arsenic, Total	mg/Kg	1.34	1.19	4.72	1.08	3.02
Barium, Total	mg/Kg	71.6	26.1	54.6	28.6	41.8
Beryllium, Total	mg/Kg	0.891	0.231 U	0.281 B	0.228 U	0.24 U
Chromium, Total	mg/Kg	17	8.69	18.4	8.38	13.2
Cobalt, Total	mg/Kg	2.11	1.7	2.72	1.74	1.54
Copper, Total	mg/Kg	8.54	3.55	11.5	4.49	10.2
Lead, Total	mg/Kg	21.6	6.93	38.7	11	40.1
Mercury, Total	mg/Kg	0.066 B	0.015 B	0.184	0.038 B	0.049 B
Nickel, Total	mg/Kg	6.39	4.07	7.19	3.17	4.92
Silver, Total	mg/Kg	0.274 B	0.069 B	0.075 B	0.028 B	0.093 B
Thallium, Total	mg/Kg	0.214 U	0.108 U	0.229 B	0.338 B	0.163 B
Tin, Total	mg/Kg	2.06 U	1.34 U	28.6	2.13 U	4.36
Vanadium, Total	mg/Kg	21.2	14.7	37.3	16.7	26.1
Zinc, Total	mg/Kg	35.6	10.9	61.2	32	52.3
Semivolatile organic compounds						
Pentachlorophenol (PCP)	ug/Kg	41 U	29 U	32 U	29 U	31 U
4-Methylphenol	ug/Kg	46 U	33 U	36 U	33 U	35 U
Benzyl alcohol	ug/Kg	39 U	28 U	31 U	28 U	29 U
Bis(2-ethylhexyl) phthalate	ug/Kg	29 U	21 U	22 U	21 U	21 U
Dibenzofuran	ug/Kg	23 U	17 U	18 U	17 U	18 U
Hexadecanoic acid	ug/Kg	--	--	--	--	--
1-phenanthrenecarboxylic acid, 1,2,3,4,	ug/Kg	--	--	--	--	--
Hexadecane	ug/Kg	--	--	--	--	--
Beta-sitosterol	ug/Kg	--	--	--	--	--
Ergosterol	ug/Kg	--	--	--	--	--
Polycyclic aromatic hydrocarbons						
2-Methylnaphthalene	ug/Kg	27 U	19 U	21 U	19 U	20 U
Acenaphthene	ug/Kg	34 U	24 U	27 U	24 U	25 U
Acenaphthylene	ug/Kg	34 U	24 U	27 U	24 U	25 U
Anthracene	ug/Kg	20 U	14 U	16 U	14 U	15 U
Fluorene	ug/Kg	18 U	13 U	14 U	13 U	14 U
Naphthalene	ug/Kg	23 U	17 U	18 U	17 U	18 U
Phenanthrene	ug/Kg	23 U	17 U	18 U	17 U	18 U

LPAH	ug/Kg	89.5	64	70.5	64	67.5
Benz(a)anthracene	ug/Kg	20 U	14 U	16 U	14 U	21 J
Benzo(a)pyrene	ug/Kg	34 U	24 U	27 U	24 U	25 U
Benzo(b)fluoranthene	ug/Kg	36 U	26 U	28 U	26 U	27 U
Benzo(g,h,i)perylene	ug/Kg	29 U	21 U	22 U	21 U	36 J
Benzo(k)fluoranthene	ug/Kg	29 U	21 U	22 U	21 U	21 U
Chrysene	ug/Kg	39 U	28 U	31 U	28 U	29 U
Fluoranthene	ug/Kg	22 U	16 U	17 U	16 U	25 J
Pyrene	ug/Kg	25 U	18 U	20 U	18 U	22 J
Dibenz(a,h)anthracene	ug/Kg	39 U	28 U	31 U	28 U	29 U
Indeno(1,2,3-cd)pyrene	ug/Kg	32 U	23 U	25 U	23 U	24 U
HPAH	ug/Kg	152.5	109.5	119.5	109.5	181.5
Total PAH	ug/Kg	242	173.5	190	173.5	249
<i>Volatile organic compounds</i>						
2-Butanone (MEK)	ug/Kg	3.1 J	1.4 U	1.6 U	1.4 U	1.5 U
Acetone	ug/Kg	22 J	8 J	7.2 J	3.2 U	3.4 U
Toluene	ug/Kg	3.7 J	0.069 U	0.076 U	0.069 U	0.075 U
<i>Other constituents</i>						
Cyanide, Total	mg/Kg	0.23 J	0.12	0.14	0.14 J	0.12

Notes:

U - not detected at detection limit shown

UJ - estimated detection limit

J - estimated

B (metals) - estimated

NJ - the analyte is tentatively identified and the result is an estimate

* - Result from Method 8270C selected ion monitoring (SIM) analysis

LPAH - low molecular weight polycyclic aromatic hydrocarbon

HPAH - high molecular weight polycyclic aromatic hydrocarbon

PAH - Polycyclic aromatic hydrocarbon

Table 3. Constituents of Interest -- Surface Water.

Station		SW-01	SW-02	SW-03	SW-04	SW-05	SW-05	SW-06
Sample		SW6001	SW6002	SW6003	SW6004	SW6005	SW6007	SW6006
Date		10/14/04	10/18/04	10/18/04	10/18/04	10/19/04	10/19/04	10/19/04
Analyte	Units						Field dup	
Metals								
Antimony, Total	mg/L	0.000236 B	0.00015 U	0.00015 U	0.00015 U	0.000342 B	0.00015 U	0.00053 B
Arsenic, Total	mg/L	0.00343	0.00285	0.016	0.00163	0.00367	0.0033	0.00321
Barium, Total	mg/L	0.0128	0.0103	0.0285	0.0223	0.0418	0.0414	0.0332
Beryllium, Total	mg/L	0.00007 B	0.00007 U	0.00007 U	0.00007 U	0.00007 U	0.00007 U	0.000088 B
Cadmium, Total	mg/L	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.000269 B
Chromium, Hexavalent, Total	mg/L	0.003	0.5 UJ	0.5 UJ	0.5 UJ	0.003 UJ	0.003 UJ	0.003 UJ
Chromium, Total	mg/L	0.00326	0.00172 B	0.00633	0.00109 U	0.00124 U	0.00139 U	0.00504
Cobalt, Total	mg/L	0.000419 B	0.000457 B	0.00124	0.000913 B	0.000876 B	0.000778 B	0.00107
Copper, Total	mg/L	0.00253	0.000874 B	0.00233	0.001 U	0.0044	0.0033	0.033
Lead, Total	mg/L	0.00128	0.000761 B	0.00106	0.00114	0.00211	0.00208	0.0139
Nickel, Total	mg/L	0.00112 B	0.000558 B	0.000799 B	0.000833 U	0.00118 B	0.0013 B	0.00418
Silver, Total	mg/L	0.000044 B	0.00004 U	0.00004 U	0.00004 U	0.00004 U	0.000052 B	0.000112 B
Thallium, Total	mg/L	0.000217 B	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.000139 B
Tin, Total	mg/L	0.000211 B	0.00011 U	0.00011 U	0.00011 U	0.000194 J	0.000301 J	0.00215 B
Vanadium, Total	mg/L	0.00275 B	0.00225 B	0.00196 B	0.00145 B	0.00235 B	0.00222 B	0.00811 B
Zinc, Total	mg/L	0.0143	0.0063 B	0.0105	0.0133 U	0.0315 J	0.0452 J	0.111
Semivolatile organic compounds								
4-Methylphenol	ug/L	0.73 U	0.75 U	0.73 U	0.8 U	0.73 U	0.73 U	29 J
Benzyl alcohol	ug/L	0.42 U	0.43 U	0.42 U	0.46 U	0.42 U	0.42 U	18 J
Bis(2-ethylhexyl) phthalate	ug/L	1.1 U	1.2 U	1.1 U	1.2 U	1.1 U	1.1 U	11
Butyl benzyl phthalate	ug/L	0.56 U	0.58 U	0.56 U	0.61 U	0.56 U	0.56 U	0.7 J
Diethyl phthalate	ug/L	0.9 U	0.92 U	0.9 U	0.98 U	0.9 U	0.9 U	4 J
Phenol	ug/L	1.7 U	1.8 U	1.7 U	1.9 U	1.7 U	1.7 U	12
Volatile organic compounds								
1,4-Dichlorobenzene	ug/L	0.085 U	0.085 U	0.085 U	0.085 U	0.085 U	0.085 U	5.4
2-Butanone (MEK)	ug/L	0.97 U	0.97 U	0.97 U	0.97 U	0.97 U	0.97 U	5.4 J
Acetone	ug/L	4.2 J	6.2 J	8.2 J	1.9 UJ	50 U	50 U	110
Chloroform	ug/L	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	3.1
Dichloromethane (Methylene Chloride)	ug/L	0.29 U	0.29 U	0.29 U	0.29 U	0.29 U	0.29 U	0.58 J
Toluene	ug/L	1 U	0.13 U	0.15 J	1 U	0.42 J	0.35 J	3.8
Chlorinated herbicides								
2,4,5-TP (Silvex)	ug/L	0.06 U	0.06 U	0.06 U	0.06 U	0.062 U	0.066 J	0.066 U
Other constituents								
Cyanide, Total	mg/L	0.0024	0.0024	0.0024	0.0024	0.0024 U	0.0024 U	0.02 J

Notes:

U - not detected at detection limit shown

UJ - estimated detection limit

J - estimated

B (metals) - estimated

Table 4. Ecological Screening Values (ESVs) for soils in mg/kg

Analyte	CCME ^A			Dutch Ministry ^B		ORNL ^C			USEPA		USFWS ^G		
	Agric EQGs	Res/Park EQGs	Comm/Indus EQGs	Target	Intervention	Soil Invertebrates	Micro-organisms	Phytotoxicity	Region IV ^D	Region V ^E	Soil Background	Moderate	Intervention
Metals													
Arsenic	12	12	12	29	40	60	100	10	10	5.7	20	30	50
Chromium, Total ⁽⁺³⁾	64	64	87	100	230	0.4	10	1	0.4	0.4 ^I	100	250	8000
Semivolatile organic compounds													
Pentachlorophenol	7.6	7.6	7.6	-	5	6	400	3	0.002	0.11927	-	-	-
Polycyclic aromatic hydrocarbons													
2-Methylnaphthalene	-	-	-	-	-	-	-	-	-	3.24	-	-	-
Acenaphthene	-	-	-	-	-	-	-	20	20	682	-	-	-
Acenaphthylene	-	-	-	-	-	-	-	-	-	682	-	-	-
Anthracene	-	-	-	-	-	-	-	-	0.1	1480	-	-	-
Fluorene	-	-	-	-	-	30	-	-	30	122	-	-	-
Naphthalene	-	0.6	22	-	-	-	-	-	0.1	0.09939	0.1	5	50
Phenanthrene	0.1	5	50	-	-	-	-	-	0.1	45.7	0.1	5	50
LPAHs	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	0.1	1	10	-	-	-	-	-	-	5.21	-	-	-
Benzo(g,h,i)perylene	-	-	-	-	-	-	-	-	-	119	-	-	-
Benzo(a)pyrene	0.1	0.7	0.7	-	-	-	-	-	0.1	1.52	0.1	1	10
Benzo[b]fluoranthene	0.1	1	10	-	-	-	-	-	-	59.8	-	-	-
Benzo[k]fluoranthene	0.1	1	10	-	-	-	-	-	-	148	-	-	-
Pyrene	0.1	10	100	-	-	-	-	-	0.1	78.5	0.1	10	100
Chrysene	-	-	-	-	-	-	-	-	-	4.73	-	-	-
Dibenz[a,h]anthracene	0.1	1	10	-	-	-	-	-	-	18.4	-	-	-
Fluoranthene	-	-	-	-	-	-	-	-	0.1	122	0.1	10	100
Indeno[1,2,3-cd]pyrene	0.1	1	10	-	-	-	-	-	-	109	-	-	-
HPAHs	-	-	-	-	-	-	-	-	-	-	-	-	-
Total PAHs	-	-	-	1	40	-	-	-	1	-	-	-	-

Notes:

^A Canadian Council of Ministers of the Environment (CCME) Environmental Quality Guidelines (EQGs) Soil Target Benchmarks for agricultural (Agri), Residential/Park (Res/Park), Commercial/Industrial (Comm/Indus) uses (CCME 2003).

^B Dutch Ministry Standards, used preferentially by EPA Region IV. The ecological Intervention Value is the concentration expected to be hazardous to 50% of the species in the ecosystem, and sensitive species protection cannot be assumed. Site concentrations less than Target Value indicate no restrictions necessary; concentrations between Target Value and Intervention Value suggests further investigation or restrictions may be warranted. Site concentrations exceeding the Intervention Value indicate remediation is necessary (Crommentuijn et al 1997; MHSPE 1994).

^C Oak Ridge National Laboratory (ORNL) Soil Screening Values. Soil Invertebrates Screening Benchmark based on toxicity to earthworms and Microbes Screening Benchmark based on toxicity to soil microorganisms (Efroymson et al 1997a). Plants Screening Benchmark based on toxicity to plants (phytotoxicity (Efroymson et al 1997b)).

^D US Environmental Protection Agency (EPA) Region IV Soil Screening Benchmark (EPA 2001).

^E US EPA Region V Ecological Screening Level (ESL) Soil Screening Benchmark (unless noted otherwise, all Soil ESLs are based on exposure to a masked shrew (Sorex cinereus)). ESLs are derived by using Equilibrium Partitioning (EqP); at least one regulatory agency questions EqP use for general screening purposes due to uncertainties regarding some assumptions used (NJDEP 1998).

^G United States Fish & Wildlife Service soil background, moderate contamination and intervention-level contamination (Beyer 1990).

^I Soil Ecological Screening Level (ESL) based on exposure to soil invertebrates (e.g., earthworms).

Table 5. Summary of occurrence of COIs and identification of CoPECs in soil (mg/kg), based on Conservative ESVs.

Analyte	Freq ^A	Undetected		Detected		Decreasing order of preference for use as ESV -->				Selected ESV ^I	CoPEC? ^J	Stations Exceeding ESVs
		Min ^B	Max ^C	Min ^B	Max ^C	EPA R4 Soil ^D	CCME Agri EQGs ^E	ORNL Plants ^G	ORNL Inverts ^H			
Metals												
Arsenic, Total	12/12	na	na	2.16	28.8	10	12	10	60	10	Yes	D1 & D2
Chromium ⁽⁺³⁾ , Total	12/12	na	na	4.05	65.8	0.4	64	1	0.4	0.4	Yes	All
Semivolatile Organic Compounds												
Pentachlorophenol (PCP)	3/12	<0.00045	<0.00052	0.110	5.400	0.002	7.6	3	6	0.002	Yes	D2-C; D1/D2-C
Polycyclic Aromatic Hydrocarbons												
2-Methylnaphthalene	1/12	<0.00069	<0.00082	0.0015	0.0015	-	-	-	-	NA	Uncertain	
Acenaphthene	3/12	<0.0011	<0.0013	0.0017	0.0190	20	-	20	-	20	No	
Acenaphthylene	3/12	<0.00072	<0.00086	0.0037	0.0900	-	-	-	-	NA	Uncertain	
Anthracene	10/12	<0.00073	<0.0008	0.0008	0.2800	0.1	-	-	-	0.1	Yes	D2-C; D1/D2-C
Fluorene	3/12	<0.00066	<0.00078	0.0018	0.062	30	-	-	30	30	No	
Naphthalene	1/12	<0.00055	<0.00065	0.0016	0.0016	0.1	-	-	-	0.1	No	
Phenanthrene	12/12	na	na	0.0024	4.400	0.1	0.1	-	-	0.1	Yes	D2-C
LPAHs	12/12			0.0043	4.852	-	-	-	-	NA	Uncertain	
Benzo(a)anthracene	12/12	na	na	0.00440	3.300	-	0.1 ^L	-	-	0.1	Yes	D2-C; D1/D2-C
Benzo(a)pyrene	9/12	<0.0017	<0.0018	0.0028	1.000	0.1	0.1	-	-	0.1	Yes	D2-C; D1/D2-C
Benzo(b)fluoranthene	12/12	na	na	0.0033	4.600	-	0.1 ^L	-	-	0.1	Yes	D2-C; D1/D2-C
Benzo(g,h,i)perylene	12/12	na	na	0.0036	0.430	-	-	-	-	NA	Uncertain	
Benzo(k)fluoranthene	4/12	<0.002	<0.0024	0.0082	0.680	-	0.1 ^L	-	-	0.1	Yes	D2-C; D1/D2-C
Chrysene	12/12	na	na	0.0038	4.300	-	-	-	-	NA	Uncertain	
Dibenz(a,h)anthracene	2/12	<0.0022	<0.0026	0.021	0.200	-	0.1 ^L	-	-	0.1	Yes	D2-C
Fluoranthene	12/12	na	na	0.007	20.00	0.1	-	-	-	0.1	Yes	D2-C; D1/D2-C
Indeno[1,2,3-cd]pyrene	12/12	na	na	0.0047	0.670	-	0.1 ^L	-	-	0.1	Yes	D2-C
Pyrene	12/12	na	na	0.006	14.00	0.1	0.1 ^L	-	-	0.1	Yes	D2-C; D1/D2-C
HPAHs	12/12			0.036	49.18	-	-	-	-	NA	Uncertain	
Total PAHs	12/12			0.0404	54.03	1.0	-	-	-	1.0	Yes	D2-C; D1/D2-C

Notes:

^A Frequency, expressed as number times detected/total number of samples.

^B Minimum; ie, lowest reported concentration or lowest analytical reporting limit (for constituent/analysis).

^C Maximum; ie, highest reported concentration or highest analytical reporting limit (for constituent/analysis).

^D US Environmental Protection Agency (USEPA) Region 4 (R4) Soil Screening Benchmark (EPA 2001).

^E Canadian Council of Ministers of the Environment (CCME) Environmental Quality Guidelines (EQGs) Soil Target Benchmarks for Agricultural Soils (CCME 2003).

^F US Environmental Protection Agency (USEPA) Toxic Equivalency Factor (TEF), used to convert concentrations of carcinogenic PAHs (cPAHs) to an equivalent concentration of benzo(a)pyrene (EPA/600/R-93/089, July 1993).

^G Oak Ridge National Laboratory (ORNL) Plants Screening Benchmark (Efroymson *et al* 1997b).

^H Oak Ridge National Laboratory (ORNL) Soil Invertebrates Screening Benchmark (Efroymson *et al* 1997a).

^I Ecological Screening Value (ESV).

^J Constituent of Potential Ecological Concern (COPEC).

^L Interim remediation criterion (CCME 1991); to be superseded by a full guideline when developed.

^M No available (NA) ESVs because posted values are at least one order of magnitude higher than ESV for Total PAHs.

Table 6. Ecological Screening Values (ESVs) for sediments in mg/kg

Analyte	Background ^A	ARCS ^B			Canadian	Consensus ^C		Dutch Ministry ^D		NOAA ^E				Ontario Ministry ^F		USEPA		
		TEC	PEC	NEC	ISQG	TEC	PEC	Target	Intervention	Lowest ARCS TEL	TEL	PEL	UET	Low	Severe	Region IV ^G	Region V ESL ^H	Region VI ^I
Metals																		
Antimony	0.16	-	-	-	-	-	-	-	-	-	-	-	3	-	-	12	-	2
Arsenic	1.1	12.1	57	92.9	5.9	9.79	33	29	55	10.8	5.9	17.0	17.0	6	33	7.24	5.9	5.9
Barium	0.7	-	-	-	-	-	-	200	625	-	-	-	-	-	-	-	-	-
Beryllium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium ⁽⁺³⁾ Total	7-13	56	159	312	37.3	43.4	111	100	380	36.3	37.3	90.0	95.0	26	110	52.3	26	37.3
Cobalt	10	-	-	-	-	-	-	20	240	-	-	-	-	-	-	-	50	-
Copper	10-25	28	77.7	54.8	35.7	31.6	149	36	190	28.012	35.7	197	86	16	110	18.7	16	35.7
Lead	4-17	34.2	396	68.7	35	35.8	128	85	530	37	35	91.3	127	31	250	30.2	31	35
Mercury	4-51	-	-	-	0.17	0.18	1.06	0.3	10	-	0.174	0.486	0.560	0.2	2	0.13	0.17	0.174
Nickel	9.9	39.6	38.5	37.9	-	22.7	48.6	35	210	19.514	18	35.9	43	16	75	15.9	16	18
Silver	<500	-	-	-	-	-	-	-	-	-	-	-	4.5	-	-	2	0.5	1
Thallium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tin	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zinc	7-38	159	1530	541	123	121	459	140	720	98	123.1	315	520	120	820	124	120	123
Semivolatile organic compounds																		
Pentachlorophenol	-	-	-	-	-	-	-	0.002	5	-	-	-	-	-	-	-	30.1	-
4-Methylphenol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000808	-
Benzyl alcohol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.03	-
Bis(2-ethylhexyl)phthalate (DEHP)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.18	0.18	-
Dibenzofuran	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.52	-
Hexadecanoic acid	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-phenanthrenecarboxylic acid, 1,2,3,4,4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hexadecane	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beta-sitosterol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ergosterol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polycyclic aromatic hydrocarbons																		
2-Methylnaphthalene	-	-	-	-	0.0202	-	-	-	-	-	-	-	-	-	-	0.33	0.02	-
Acenaphthene	-	-	-	-	0.00671	-	-	-	-	-	-	-	0.29	-	-	0.33	0.00671	-
Acenaphthylene	-	-	-	-	0.00587	-	-	-	-	-	-	-	0.16	-	-	0.33	0.00587	-
Anthracene	-	0.03	0.54	1.7	0.0469	0.05	0.84	-	-	0.01	-	-	0.26	0.22	3.7	0.33	0.04	0.0572
Fluorene	-	0.03	0.65	1.8	0.0212	0.07	0.53	-	-	0.01	-	-	0.3	0.19	1.6	0.33	0.02	0.0774
Naphthalene	-	0.03	0.68	0.29	0.0346	0.17	0.56	-	-	0.01465	-	-	0.6	-	-	0.33	0.03	0.176
Phenanthrene	-	-	-	-	0.0419	0.2	1.17	-	-	0.01873	0.0419	0.515	0.8	0.56	9.5	0.33	0.04	0.0419
LPAHs																		
Benz(a)anthracene	-	0.78	3.37	3.04	-	-	-	-	-	0.07642	-	-	5.3	-	-	0.33	-	-
Benz(a)pyrene	-	0.26	4.2	3.5	0.0317	0.1	1.05	-	-	0.01572	0.0317	0.385	0.5	0.32	14.8	0.33	0.03	0.0317
Benzo(a)pyrene	-	0.35	0.39	0.44	0.0319	0.15	1.45	-	-	0.0324	0.0319	0.782	0.7	0.37	14.4	0.33	0.03	0.0319
Benzo(b)fluoranthene	-	0.02	-	4	-	-	-	-	-	-	-	-	0.3	-	-	-	10.4	-
Benzo(k)fluoranthene	-	0.02	-	4	-	-	-	-	-	0.272	-	-	13.4	0.24	13.4	-	0.24	-
Benzo[g,h,i]perylene	-	0.29	6.3	3.8	-	-	-	-	-	-	-	-	0.300	0.17	3.2	-	0.17	-
Chrysene	-	0.5	5.2	4	0.051	0.16	1.29	-	-	0.02683	0.0571	0.862	0.8	0.34	4.6	0.33	0.05	0.0571
Dibenz[a,h]anthracene	-	-	0.02	0.87	0.00622	0.03	-	-	-	0.010	-	-	0.100	0.06	1.3	0.33	0.00622	0.033
Fluoranthene	-	0.06	0.83	7.5	0.111	0.42	2.23	-	-	0.03146	0.111	2.355	1.5	0.75	10.2	0.33	0.11	0.111
Indeno[1,2,3-c,d]pyrene	-	0.07	0.83	3.8	-	-	-	-	-	0.01732	-	-	0.330	0.2	3.2	-	0.2	-
Pyrene	-	0.57	3.23	6.1	0.053	0.19	1.52	-	-	0.04427	0.053	0.875	1	0.49	8.5	0.33	0.05	0.053
HPAHs	-	2.9	4.35	51	-	-	-	-	-	0.19295	-	-	6.5	-	-	0.65	-	-
Total PAHs	-	3.55	13.7	84.6	-	1.61	22.8	1	40	0.26405	-	-	12	4	100	1.68	-	4
Volatile organic compounds																		
Acetone	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.45	-
2-Butanone	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.13	-
Toluene	-	-	-	-	-	-	-	0.05	130	-	-	-	-	-	-	-	52.5	-
Other constituents																		
Cyanide, Free	-	-	-	-	-	-	-	1	20	-	-	-	-	-	-	-	0.0001	-

Notes:

^A Background values are derived from a compilation of sources, but come primarily from Int Noint Comm Sediment Subcommittee (1988).

^B US Environmental Protection Agency (USEPA) Assessment and Remediation of Contaminated Sediments (ARCS) Program. Effects-based sediment concentrations (majority of the data are for freshwater sediments) for the amphipod *Hyalalella azteca* and the midge *Chironomus riparius*. The TEC are possible-effects benchmarks representing the upper limit of the range of concentrations that dominate the no effects data, such that concentrations above the TEC may result in adverse effects to these organisms and concentrations below the TEC are unlikely to result in adverse effects. The PEC are probable-effects benchmarks representing the lower limit of the range of concentrations usually associated with adverse effects, such that a concentration greater than the PEC is likely to result in adverse effects to these organisms. The NEC are representative effect concentrations selected from among the high no-effect-concentrations and are concentrations above which statistically significant adverse biological effects always occur. Effects may occur below these levels as well. The majority of the data are for freshwater sediments. (EPA 905/R96/008, 1996).

^C Consensus-based Sediment Quality Guidelines (SQG) represent the geometric mean of published SQGs from a variety of sources. Sources for Threshold Effect Concentrations (TEC) include threshold effect levels, effect range low values, lowest effect levels, minimal effect thresholds, and sediment quality advisory levels, and are intended to identify contaminant concentrations below which harmful effects on sediment-dwelling organisms are not expected. Sources for Probable Effect Concentrations (PEC) include probable effect levels, effect range median values, severe effect levels, and toxic effect thresholds, and are intended to identify contaminant concentrations above which harmful effects on sediment-dwelling organisms are expected to occur more often than not. (MacDonald *et al* 2000)

^D Dutch Ministry Standards, used preferentially by EPA Region IV. The ecological Intervention Value is the concentration expected to be hazardous to 50% of the species in the ecosystem, and sensitive species protection cannot be assumed. Site concentrations less than Target Value indicate no restrictions necessary; concentrations between Target Value and Intervention Value suggests further investigation or restrictions may be warranted. Site concentrations exceeding the Intervention Value indicate remediation is necessary (MHSPE 1994).

^E National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (SQUIRTs). Multiple sediment screening values were compiled to derive conservative lower-threshold values (Threshold Effects Level (TEL)) and upper thresholds (Probable Effects Levels (PELs)). PELs are more closely representative of toxic levels and are lowest reliable value among a compilation of impacts to infaunal benthic communities, *Hyalalella azteca* bioassays and microtox bioassays. Upper Effects Thresholds (UETs) represent the lower limits of toxic effects to infaunal invertebrates (Buchman 1999).

^F Ontario Ministry of the Environment and Energy Low and Severe Effects Ecological Benchmarks (Persaud *et al* 1993).

^G USEPA Region IV Sediment Screening Benchmarks are possible effects benchmarks, derived from the higher of the EPA Contract Laboratory Program Practical Quantitation Limit and the Effects Value, which is the lower of the ER-L and the TEL (EPA Region IV 1995).

^H USEPA Region V Ecological Screening Level (ESL) Sediment Screening Benchmark. The ESL reference database consists of Region 5 media-specific (soil, water, sediment, and air) ESLs for RCRA Appendix IX hazardous constituents. The ESLs are initial screening levels with which the site contaminant concentrations can be compared (EPA Region V 2003).

^I USEPA Region VI Sediment Screening Benchmarks: Freshwater Sediment. These benchmarks are conservative screening level values intended to be protective of benthic biota. Values were compiled from a prioritized list of published values. The primary benchmarks are Threshold Effects Levels (TELs) from Smith *et al.* (1996), but values for antimony and silver are Effect Range-Low (ER-L) values from Long and Morgan (1990), values for iron, manganese, total PAHs, several pesticides, and PCBs are Lowest Effects Levels (LELs) from Persaud *et al.* (1993), anthracene, dibenz(a,h)anthracene, and naphthalene are Threshold Effect Concentrations (TECs) from MacDonald *et al.* (2000), and sum DDT, DDE, and DDD values are from Environment Canada (1997). (TNRCC 2001)

Table 7. Summary of occurrence of COIs and identification of CoPECs in sediment, Church House Branch (mg/kg)

Analyte	Freq ^A	Undetected		Detected		Back-ground ^D	Most conservative benchmark used preferentially									Selected ESV ^M		CoPEC ^P	Stations Exceeding ESVs ^Q or Uncertainties		
		Min ^B	Max ^C	Min ^B	Max ^C		ARCS ^E	Canadian	Cnsns ^F	Dutch ^G	NOAA ^H	Ontario ^I	USEPA			Direct ^N	Indirect [NOAE] ^O				
							TEC	ISQG	TEC	Target	ARCS TEL	TEL	Ontario Low	Region IV ^J	Region V ^K					Region VI ^L	
Metals																					
Antimony, Total	4/11	<0.080	<0.593	0.109	0.608	0.16	-	-	-	-	-	-	-	12	-	2	2	NA	N	SD01, SD02, SD04, SD06, S	
Arsenic, Total	10/11	<0.269	<0.269	0.664	4.72	1.1	12.1	5.9	9.79	29	10.8	5.9	6	7.24	5.9	5.9	5.9	114	N/N		
Barium, Total	11/11	na	na	19.9	71.6	0.7	-	-	-	200	-	-	-	-	-	-	200	NA	N		
Beryllium, Total	5/11	<0.231	<0.270	0.281	0.891	-	-	-	-	-	-	-	-	-	-	-	NA	NA	Uncertain		
Chromium ⁽⁺³⁾ , Total	11/11	na	na	4.47	18.4	7-13	56	37.3	43.4	100	36.3	37.3	26	52.3	26	37.3	26	43.4	N/N		
Cobalt, Total	11/11	na	na	0.58	2.72	10	-	-	-	20	-	-	-	-	50	-	20	NA	N		
Copper, Total	11/11	na	na	1.68	11.5	10-25	28	35.7	31.6	36	28.012	35.7	16	18.7	16	35.7	16	31.6	N/N		
Lead, Total	11/11	na	na	6.53	40.1	4-17	34.2	35	35.8	85	37	35	31	30.2	31	35	30.2	29	Y/Y		SD08, SD10
Mercury, Total	10/10	na	na	0.015	0.184	4-51	-	0.17	0.18	0.3	-	0.174	0.2	0.13	0.17	0.174	0.13	NA	Y		SD08
Nickel, Total	11/11	na	na	1.4	7.19	9.9	39.6	-	22.7	35	19.514	18	16	15.9	16	18	15.9	NA	N		
Silver, Total	10/11	<0.085	<0.085	0.028	0.274	<500	-	-	-	-	-	-	-	2	0.5	1	0.5	NA	N		
Thallium, Total	4/11	<0.072	<0.214	0.163	0.338	-	-	-	-	-	-	-	-	-	-	-	NA	NA	Uncertain	SD01,SD08, SD09,SD10	
Tin, Total	2/11	<1.01	<2.13	4.63	28.60	5	-	-	-	-	-	-	-	-	-	-	NA	NA	Uncertain	SD08, SD10	
Vanadium, Total	11/11	na	na	7.9	37.3	50	-	-	-	-	-	-	-	-	-	-	NA	NA	Uncertain	All	
Zinc, Total	11/11	na	na	6.5	61.2	7-38	159	123	121	140	98	123.1	120	124	120	123	98	NA	N		
Semivolatile Organic Compounds																					
4-Methylphenol	2/11	<0.033	<0.046	0.053	0.18	-	-	-	-	-	-	-	-	-	0.000808	-	0.000808 ^S	NA	Y	SD04, SD05	
Benzyl alcohol	1/11	<0.028	<0.034	0.062	0.062	-	-	-	-	-	-	-	-	-	0.03	-	0.03 ^S	NA	Y	SD04	
Bis(2-ethylhexyl)phthalate (DEHP)	3/11	<0.021	<0.029	0.056	0.070	-	-	-	-	-	-	-	-	0.18	0.18	-	0.18	NA	N		
Dibenzofuran	1/11	<0.017	<0.023	0.270	0.270	-	-	-	-	-	-	-	-	-	1.52	-	1.52	NA	N		
Pentachlorophenol	4/11	<0.029	<0.041	0.025	1.500	-	-	-	-	0.002	-	-	-	-	30.1	-	0.002 ^U	0.02	Y/Y	SD-01, SD03, SD04, SD05	
Hexadecanoic acid	1/11	na	na	0.320	0.320	-	-	-	-	-	-	-	-	-	-	-	NA	NA	Uncertain	SD01	
1-phenanthrenecarboxylic acid, 1,2,3,4,4	1/11	na	na	0.390	0.390	-	-	-	-	-	-	-	-	-	-	-	NA	NA	Uncertain	SD01	
Hexadecane	1/11	na	na	0.460	0.460	-	-	-	-	-	-	-	-	-	-	-	NA	NA	Uncertain	SD01	
Beta-sitosterol	1/11	na	na	0.960	0.960	-	-	-	-	-	-	-	-	-	-	-	NA	NA	Uncertain	SD01	
Ergosterol	1/11	na	na	0.540	0.540	-	-	-	-	-	-	-	-	-	-	-	NA	NA	Uncertain	SD01	
Polycyclic Aromatic Hydrocarbons																					
2-Methylnaphthalene	1/11	<0.019	<0.023	0.030	0.030	-	-	0.0202	-	-	-	-	-	0.33	0.02	-	0.02 ^S	NA	Y	SD04	
Acenaphthene	1/11	<0.024	<0.034	0.400	0.400	-	-	0.00671	-	-	-	-	-	0.33	0.00671	-	0.00671 ^S	NA	Y	SD04	
Acenaphthylene	1/11	<0.024	<0.034	0.054	0.054	-	-	0.00587	-	-	-	-	-	0.33	0.00587	-	0.00587 ^S	NA	Y	SD04	
Anthracene	2/11	<0.014	<0.020	0.0015	0.420	-	0.03	0.0469	0.05	-	0.01	-	0.22	0.33	0.04	0.0572	0.01 ^S	NA	Y	SD04	
Fluorene	1/11	<0.013	<0.018	0.470	0.470	-	0.03	0.0212	0.07	-	0.01	-	0.19	0.33	0.02	0.0774	0.01 ^S	NA	Y	SD04	
Naphthalene	1/11	<0.017	<0.023	0.029	0.029	-	0.03	0.0346	0.17	-	0.01465	-	-	0.33	0.03	0.176	0.01465 ^S	NA	Y	SD04	
Phenanthrene	4/11	<0.017	<0.023	0.004	1.300	-	-	0.0419	0.2	-	0.01873	0.0419	0.56	0.33	0.04	0.0419	0.01873 ^U	NA	Y	SD03, SD04	
LPAHs	11/11			<0.064	2.703	-	0.78	-	-	-	0.07642	-	-	-	-	-	0.07642	NA	Y	SD04	
Benzo(a)anthracene	2/11	<0.014	<0.020	0.021	0.830	-	0.26	0.0317	0.1	-	0.01572	0.0317	0.32	0.33	0.03	0.0317	0.01572 ^S	NA	Y	SD04, SD10	
Benzo(a)pyrene	0/11	<0.024	<0.350	na	na	-	0.35	0.0319	0.15	-	0.0324	0.0319	0.37	0.33	0.03	0.0319	0.0319	NA	Uncertain	All	
Benzo(b)fluoranthene	1/11	<0.026	<0.310	0.400	0.400	-	0.02	-	-	-	-	-	-	-	10.4	-	0.02 ^S	NA	Y	SD04	
Benzo(g,h,i)perylene	1/11	<0.021	<0.300	0.036	0.036	-	0.29	-	-	-	-	-	0.17	-	0.17	-	0.17	NA	N		
Benzo(k)fluoranthene	1/11	<0.021	<0.250	0.430	0.430	-	0.02	-	-	-	0.272	-	0.24	-	0.24	-	0.02 ^S	NA	Y	SD04	
Chrysene	1/11	<0.028	<0.034	0.960	0.960	-	0.5	0.051	0.16	-	0.02683	0.0571	0.34	0.33	0.05	0.0571	0.02683 ^S	NA	Y	SD04	
Dibenz(a,h)anthracene	0/11	<0.028	<0.410	na	na	-	-	0.00622	0.03	-	0.010	-	0.06	0.33	0.00622	0.033	0.00622	NA	Uncertain	All	
Fluoranthene	6/11	<0.016	<0.022	0.0039	4.900	-	0.06	0.111	0.42	-	0.03146	0.111	0.75	0.33	0.11	0.111	0.06	NA	Y	SD04	
Indeno[1,2,3-cd]pyrene	0/11	<0.023	<0.330	na	na	-	0.07	-	-	-	0.01732	-	0.2	-	0.2	-	0.01732	NA	Uncertain	All	
Pyrene	5/11	<0.018	<0.025	0.0062	2.500	-	0.57	0.053	0.19	-	0.04427	0.053	0.49	0.33	0.05	0.053	0.04427	NA	Y	SD03, SD04	
HPAHs				<0.1095	10.715	-	2.9	-	-	-	0.19295	-	-	0.65	-	-	0.19295	NA	Y	SD04	
Total PAHs				<0.1735	13.418	-	3.55	-	1.61	1	0.26405	-	4	1.68	-	4	0.26405	NA	Y	SD04	
Volatile Organic Compounds																					
2-Butanone (MEK)	4/11	<0.0014	<0.0017	0.0031	0.0063	-	-	-	-	-	-	-	-	-	0.13	-	0.13	NA	N		
Acetone	8/11	<0.0032	<0.0034	0.0072	0.042	-	-	-	-	-	-	-	-	-	0.45	-	0.45	NA	N		
Toluene	4/11	<0.000069	<0.000085	0.0037	0.029	-	-	-	-	0.05	-	-	-	-	52.5	-	0.05	-	N		
Other constituents																					
Cyanide, Free	11/11	na	na	0.12	0.23	-	-	-	-	1	-	-	-	-	0.0001	-	0.0001	NA	Y	All	

Notes:

^a Frequency, expressed as number times detected/total number of samples.

^b Minimum; ie, lowest reported concentration or lowest analytical reporting limit (for constituent/analysis).

^c Maximum; ie, highest reported concentration or highest analytical reporting limit (for constituent/analysis).

^d Background values are derived from a compilation of sources, but come primarily from Int Noint Comm Sediment Subcommittee (1988).

^e US Environmental Protection Agency (USEPA) Assessment and Remediation of Contaminated Sediments (ARCS) Program. Effects-based sediment concentrations (majority of the data are for freshwater sediments) for the amphipod *Hyalella azteca* and the midge *Chironomus riparius*. The TEC are possible-effects benchmarks representing the upper limit of the range of concentrations that dominate the no effects data, such that concentrations above the TEC may result in adverse effects to these organisms and concentrations below the TEC are unlikely to result in adverse effects. Effects may occur below these levels as well. (EPA 905/R96/008, 1996).

^f Consensus-based Sediment Quality Guidelines (SQG) represent the geometric mean of published SQGs from a variety of sources. Sources for Threshold Effect Concentrations (TEC) include threshold effect levels, effect range low values, lowest effect levels, minimal effect thresholds, and sediment quality advisory levels, and are intended to identify contaminant concentrations below which harmful effects on sediment-dwelling organisms are not expected. (MacDonald *et al* 2000)

^g Dutch Ministry Standards, used preferentially by EPA Region IV. Site concentrations less than Target Value indicate no restrictions necessary. (MHSPE 1994).

^h National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (SQUIRTs). Multiple sediment screening values were compiled to derive conservative lower-threshold values (Threshold Effects Level (TEL)) and upper thresholds (Probable Effects Levels (PELs)). PELs are more closely representative of toxic levels and are lowest reliable value among a compilation of impacts to infaunal benthic communities, *Hyalella azteca* bioassays and microtox bioassays. (Buchman 1999).

ⁱ Ontario Ministry of the Environment and Energy Lowest Effects Level (LELs) Ecological Benchmarks (Persaud *et al* 1993).

^j USEPA Region IV Sediment Screening Benchmarks are possible effects benchmarks, derived from the higher of the EPA Contract Laboratory Program Practical Quantitation Limit and the Effects Value, which is the lower of the ER-L and the TEL (EPA Region IV 1995).

^k USEPA Region V Ecological Screening Level (ESL) Sediment Screening Benchmark. The ESL reference database consists of Region 5 media-specific (soil, water, sediment, and air) ESLs for RCRA Appendix IX hazardous constituents. The ESLs are initial screening levels with which the site contaminant concentrations can be compared (EPA Region V 2003).

^l USEPA Region VI Sediment Screening Benchmarks: Freshwater Sediment. These benchmarks are conservative screening level values intended to be protective of benthic biota. Values were compiled from a prioritized list of published values. The primary benchmarks are Threshold Effects Levels (TELs) from Smith *et al*. (1996), but values for antimony and silver are Effect Range-Low (ER-L) values from Long and Morgan (1990), values for iron, manganese, total PAHs, several pesticides, and PCBs are Lowest Effects Levels (LELs) from Persaud *et al*. (1993), anthracene, dibenz(a,h)anthracene, and naphthalene are Threshold Effect Concentrations (TECs) from MacDonald *et al* (2000), and sum DDT, DDE, and DDD values are from Environment Canada (1997). (TNRC 2001)

^m Ecological Screening Value (ESV).

ⁿ Direct exposure ESVs

^o Indirect exposure (ingestion-pathway) ESVs are dry-weight bulk sediment concentrations derived by back-calculation from no-observed-adverse-effects-level (NOAEL) doses to sensitive birds or mammals (i.e., the lowest dietary NOAEL among several for each COI).

^p Constituent of Potential Ecological Concern [CoPEC]

^q SD01 - SD04: Downstream of IP property; SD05: On IP property west boundary; SD06 - SD10: Upstream of IP property

^s ESV lower than minimum detection level

Table 8. Ecological Screening Values (ESVs) for surface water in mg/L.

Analyte	CWQG for Aquatic Life ^A	USEPA				NAWQC SW ^E		Tier II SW ^F	
		EPA CCC ^B	Region IV SW RAGS ^C		Region VI FW SW ^D				
			Acute	Chronic		Acute	Chronic	SAV	SCV
Metals									
Antimony, Total	-	-	1.3	0.16	0.692	-	-	0.18	0.03
Arsenic, Total	0.005	0.150	0.36	0.19	0.19	0.34	0.15	-	-
Barium, Total	-	-	-	-	0.004	-	-	0.11	0.004
Beryllium, Total	-	-	0.01	0.00053	0.0053	-	-	0.03	0.00066
Cadmium, Total	0.000017	0.00025	0.00179	0.00066	0.0006	0.0043	0.0022	-	-
Chromium [III], Total	0.0089	0.074	0.98	0.11	0.1008	0.57	0.07	-	-
Chromium Hexavalent [VI], Total	0.001	0.011	0.01	0.01	0.0106	0.01	0.01	-	-
Cobalt, Total	-	-	-	-	1.5	-	-	1.5	0.02
Copper, Total	0.002	0.0090	0.00922	0.00654	0.007	0.01	0.009	-	-
Lead, Total	0.002	0.0025	0.03	0.00132	0.001	0.06	0.0025	-	-
Nickel, Total	0.065	0.052	0.78	0.08	0.0874	0.47	0.05	-	-
Silver, Total	0.0001	-	0.00123	0.000012	0.00011	0.0034	-	-	0.00036
Thallium, Total	0.0008	-	0.14	0.004	0.04	-	-	0.11	0.01
Tin, Total	-	-	-	-	0.073	-	-	2.7	0.07
Vanadium, Total	-	-	-	-	0.02	-	-	0.28	0.02
Zinc, Total	0.05	0.12	0.06	0.05	0.0581	0.12	0.12	-	-
Semivolatile organic compounds									
4-Methylphenol	-	-	-	-	0.543	-	-	-	-
Benzyl Alcohol	-	-	-	-	0.0086	-	-	0.15	0.0086
Bis(2-ethylhexyl) Phthalate	0.016	-	1.11	0.0003	0.007	-	-	0.02	0.003
Butyl Benzyl Phthalate	-	-	0.33	0.02	0.093	-	-	-	0.01
Diethyl Phthalate	-	-	5.21	0.52	2.09	-	-	1.8	0.21
Phenol	-	-	1.02	0.25	0.11	-	-	-	-
Volatile organic compounds									
1,4-Dichlorobenzene	0.026	-	0.11	0.01	0.11	-	-	0.18	0.01
2-Butanone (MEK)	-	-	-	-	84.80	-	-	240.00	14.00
Acetone	-	-	-	-	202.4	-	-	28	1.5
Chloroform	0.0018	-	2.89	0.28	0.89	-	-	0.49	0.02
Dichloromethane (Methylene Chloride)	0.0981	-	19.3	1.93	22	-	-	26	2.2
Toluene	0.002	-	1.75	0.17	2.9	-	-	0.12	0.0098
Chlorinated pesticides									
2,4,5-TP (Silvex)	-	-	-	-	-	-	-	-	-
Other constituents									
Cyanide, Total	0.005	0.0052	0.02	0.0052	0.0107 ^G	0.02	0.0052	-	-

Table 8. Continued

^A Canadian Water Quality Guidelines (CWQG) Surface Water Screening Benchmark (CCME 2003).

^B US Environmental Protection Agency (EPA) Criteria Continuous Concentration (CCC) - EPA 2002).

^C US Environmental Protection Agency (EPA) Region IV (R4) Surface Water (SW) Screening Benchmarks (EPA 2001).

^D US Environmental Protection Agency (EPA) Region VI (R6) Fresh Water (FW) Surface Water Screening Benchmarks for aquatic biota (TNRCC 2001).

^E National Ambient Water Quality Criteria (NAWQC) Surface Water (SW) Screening Benchmarks. NAWQC for several metals are functions of water hardness. Recommended values for metals are expressed in terms of dissolved metal in the water column (EPA 2002).

^F Tier II Secondary Value Surface Water Screening Benchmarks (Suter and Tsao 1996).

^G Value is for Cyanide, Total Free.

Table 9. Summary of occurrence of COIs and identification of CoPECs in surface water, Church House Branch (mg/L).

Analyte		Undetected		Detected		Most conservative benchmark used preferentially						Selected ESV ^J	CoPEC? ^K	Stations Exceeding ESVs ^L
	Freq ^A	Min ^B	Max ^C	Min ^B	Max ^C	EPA CCC ^D	EPA R4 SW RAGS Chronic ^E	Tier II SCV SW ^F	NAWQC SW Chronic ^G	CWQG for Aquatic Life ^H	EPA R6 FW SW ^I			
Metals														
Antimony, Total	3/7	<0.00015	<0.00015	0.00024	0.00053	-	0.16	0.03	-	-	0.692	0.03	No	
Arsenic, Total	7/7	na	na	0.00163	0.016	0.150	0.19	-	0.15	0.005	0.19	0.005	Yes	SW03
Barium, Total	7/7	na	na	0.0103	0.0418	-	-	0.004	-	-	0.004	0.004	Yes	All
Beryllium, Total	2/7	<0.00007	<0.00007	0.00007	0.000088	-	0.00053	0.00066	-	-	0.0053	0.00053	No	
Cadmium, Total	1/7	<0.0001	<0.0001	0.00027	0.00027	0.00025	0.00066	-	0.0022	0.000017	0.0006	0.000017 ^M	Yes	SW06
Chromium [III], Total	4/7	<0.00109	<0.00139	0.00172	0.00633	0.074	0.11	-	0.07	0.0089	0.1008	0.0089	No	
Chromium Hexavalent [VI], Total	1/7	<0.003	<0.05	0.003	0.003	0.011	0.01	-	0.01	0.001	0.0106	0.001	Yes	SW01
Cobalt, Total	7/7	na	na	0.00042	0.00124	-	-	0.02	-	-	1.5	0.02	No	
Copper, Total	6/7	<0.001	<0.001	0.00087	0.033	0.0090	0.00654	-	0.009	0.002	0.007	0.002	Yes	SW01, SW03, SW05, SW06
Lead, Total	7/7	na	na	0.00076	0.0139	0.0025	0.00132	-	0.0025	0.002	0.001	0.001	Yes	All sans SW02
Nickel, Total	7/7	na	na	0.00056	0.00418	0.052	0.08	-	0.05	0.065	0.0874	0.05	No	
Silver, Total	3/7	<0.00004	<0.00004	0.000044	0.00011	-	0.000012	0.00036	-	0.0001	0.00011	0.0001	Yes	SW06
Thallium, Total	2/7	<0.00013	<0.00013	0.00014	0.00022	-	0.004	0.01	-	0.0008	0.04	0.0008	No	
Tin, Total	4/7	<0.00011	<0.00011	0.00019	0.00215	-	-	0.07	-	-	0.073	0.07	No	
Vanadium, Total	7/7	na	na	0.00145	0.00811	-	-	0.02	-	-	0.02	0.02	No	
Zinc, Total	6/7	<0.0133	<0.0133	0.0063	0.111	0.12	0.05	-	0.12	0.05	0.0581	0.05	Yes	SW06
Semivolatile Organic Compounds														
4-methylphenol	7/7	<0.00075	<0.00080	0.029	0.029	-	-	-	-	-	0.543	0.543	No	
Benzyl Alcohol	1/7	<0.00042	<0.00046	0.018	0.018	-	-	0.0086	-	-	0.0086	0.0086	Yes	SW06
Bis(2-ethylhexyl) Phthalate	1/7	<0.0011	<0.0012	0.011	0.011	-	0.0003	0.003	-	0.016	0.007	0.0003	Yes	SW06
Butyl Benzyl Phthalate	1/7	<0.00056	<0.00061	0.0007	0.0007	-	0.02	0.01	-	-	0.093	0.02	No	
Diethyl Phthalate	1/7	<0.00090	<0.00098	0.004	0.004	-	0.52	0.21	-	-	2.09	0.21	No	
Phenol	1/7	<0.0017	<0.0019	0.0120	0.0120	-	0.25	-	-	-	0.11	0.11	No	
Volatile Organic Compounds														
1,4-Dichlorobenzene	1/7	<0.000085	<0.000085	0.0054	0.0054	-	0.01	0.01	-	0.026	0.11	0.01	No	
2-Butanone (MEK)	1/7	<0.00097	<0.00097	0.0054	0.0054	-	84.80	14.00	-	-	-	14.00	No	
Acetone	4/7	<0.05	<0.0019	0.0042	0.110	-	-	1.5	-	-	202.4	1.50	No	
Chloroform	1/7	<0.00012	<0.00012	0.0031	0.0031	-	0.28	0.02	-	0.0018	0.89	0.0018	Yes	SW06
Dichloromethane (Methylene Chloride)	1/7	<0.00029	<0.00029	0.00058	0.00058	-	1.93	2.2	-	0.0981	22	0.0981	No	
Toluene	4/7	<0.00013	<0.001	0.00015	0.0038	-	0.17	0.0098	-	0.002	2.9	0.002	Yes	SW06
Chlorinated pesticides														
2,4,5-TP (silvex)	1/7	<0.00006	<0.000066	0.000066	0.000066	-	-	-	-	-	-	-	Uncertain	SW05
Other constituents														
Cyanide, Total	6/7	<0.0024	<0.0024	0.0024	0.0200	0.0052	0.0052	-	0.0052	0.005	0.0107 ^N	0.005	Yes	SW06

Notes:

^A Frequency, expressed as number times detected/total number of samples.

^B Minimum; ie, lowest reported concentration or lowest analytical reporting limit (for constituent/analysis).

^C Maximum; ie, highest reported concentration or highest analytical reporting limit (for constituent/analysis).

^D USEPA Freshwater Criterion Continuous Concentration (EPA 2002).

^E EPA R4 - Chronic Surface Water Screening Benchmark (EPA 2001).

^F Tier II Secondary Chronic Value (SCV) Surface Water Screening Benchmark (Suter and Tsao 1996).

^G Chronic National Ambient Water Quality Criteria (NAWQC) Chronic Surface Water Screening Benchmark (EPA 2002).

^H Canadian Water Quality Guidelines (CWQG) Surface Water Screening Benchmark (CCME 2003).

^I SW EPA REGION VI (R6) Fresh Water (FW) Surface Water Screening Benchmark for aquatic biota (TNRCC 2001).

^J Ecological Screening Value (ESV).

^K Constituent of Potential Ecological Concern (CoPEC).

^L SW01 - SW02: Downstream of IP Property; SW03: On IP property west boundary; SW04 - SW06: Upstream of IP property.

^M ESV exceeds MDL.

^N Value is for Cyanide, Total Free.

Appendix A

Data Quality Assurance Review



981 State Street
Raymond, WA 98577

Phone 360.942.3409
Fax 360.942.6060
kgunderson@premiercorp-usa.com

Memorandum

Date: March 14, 2005
To: Les Brewer, Premier Environmental Services, Inc.
From: Kathy J. Gunderson, Premier Environmental Services, Inc.
Subject: Quality Assurance Review
Project: Corrective Measures Study
International Paper Treated Wood Products Plant, Wiggins,
Mississippi
Sampling Dates: October 13, 14, 15, 16, 17, and 18, 2004

1.0 Introduction

This quality assurance review presents the validation of the sample analyses listed in Table 1. The analyses were performed by Columbia Analytical Services laboratories located in Jacksonville, Florida; Kelso Washington; and Redding California. The criteria used to qualify data are from the *Appendix A Quality Assurance Project Plan (QAPP)* (Exponent 1999), the *Corrective Measures Study Work Plan International Paper Company Treated Wood Products Plant, Wiggins Mississippi* (Premier 2004), the *Contract Laboratory Program National Functional Guidelines for Inorganic and Organic Data Review* (USEPA 1994 and 1999), the analytical methods, or the professional judgment of the validation chemist.

A two tiered validation approach was utilized in the review of this data set. A Level III review was performed on approximately half of the data; a cursory review was performed on the remaining data. A Level III review is more rigorous than a cursory review as a Level III review includes an assessment of instrument performance and calibration. Since the Level III review demonstrated that the laboratory was following method-required procedures for instrument performance and calibration, the level of validation was decreased to cursory for the remaining data. Table 1 lists the level of validation performed on each samples data. The following laboratory deliverables were reviewed during the validation process:

- Chain-of-custody (COC) documentation to assess holding times and verify report completeness
- Laboratory QC sample results, including method blanks, surrogate spikes, laboratory control samples (LCSs), matrix spike/matrix spike duplicates (MS/MSDs), and laboratory duplicates. Level III validation includes an evaluation of instrument performance checks, initial calibration, and calibration verifications.
- Analytical results to verify reporting limits
- Field QC samples to assess field blank contamination and field duplicate precision

Field duplicate precision is presented in Tables 2, 3, and 4, and the qualified data are summarized in a Table 5 at the end of this memorandum. Data qualifier flags have been added to the sample results in the original laboratory reports and database files.

2.0 Validation Findings

2.1 Custody, Preservation, and Completeness – Acceptable with Discussion

Sample custody was maintained as required from sample collection to receipt at the laboratory. The samples were received intact and were properly preserved. Except as noted below, the reports are complete and contain results for all samples and tests requested on the COC forms.

- Mercury results were not reported for sample SD6001. Only arsenic and chromium were originally reported for sample SD6001, even though the COC requests full metals analysis as specified in the Work Plan. The laboratory resubmitted all the missing metals results, except mercury.
- The grain size distribution curves were missing from the data packages. The missing information was resubmitted by the laboratory.
- The laboratory does not analyze for famphur, thionazin, or o,o,o-triethyl phosphorothioate by Method 8141A. These analytes will be included in the semivolatile organic water analyses. To ensure that these compounds are not present in the soil samples, tentatively identified compounds were reported with the semivolatile organic analyses for the Church House Branch soil samples.
- The tentatively identified compound raw data was missing for the J0402994 data package. The missing information was resubmitted by the laboratory.

- The sample Rinse Blank-Soil collected 10-15-04 (J0403038-003) was not analyzed for chlorinated herbicides, cyanide, hexavalent chromium, metals, total organic carbon, or pH due to insufficient sample volume supplied to the laboratory. Grain size analyses can not be performed on water samples.
- The sample Soil Rinse Blank collected 10-18-04 (J0403038-015) was not analyzed due to laboratory error.
- In the electronic data deliverable (EDD) file for sample delivery group (SDG) J0403074, the total cyanide results of samples SW6005 and SW6007 were incorrectly flagged X. The database file has been amended with the correct U flag.

3.0 Level III Data Validation

3.1 Volatile Organic Analyses

3.1.1 Holding Times – Acceptable

The samples were analyzed within the required holding time of 14 days from collection for soil and preserved water samples.

3.1.2 Instrument Tuning and Mass Calibration – Acceptable

The tuning compound bromofluorobenzene was analyzed at the required frequency and all relative abundance values are acceptable.

3.1.3 Initial Calibration – Acceptable with Qualifications

Initial calibrations were analyzed at the required frequency. The Work Plan criteria of relative standard deviation (RSD) values less than or equal to 30 percent and relative response factors (RRFs) greater than 0.1 were met, with the following exceptions.

- The average RRF values of acrolein, acetonitrile, acetone, acrylonitrile, propionitrile, isobutyl alcohol, and 1,4-dioxane are below Work Plan criteria (values range from 0.0029 to 0.0891) in the 10-5-04 initial calibration. Data qualifiers are not required because project samples are not associated with this initial calibration.
- The average RRF values of acrolein, acetone, acetonitrile, acrylonitrile, propionitrile, isobutyl alcohol, and 1,4-dioxane are below the Work Plan criteria (values range from 0.00234 to 0.0861) in the 10-25-04 initial calibration. A low RRF affects the ability of the instrument to detect positive results below the calibration range. The acrolein, acetone, acetonitrile, acrylonitrile, propionitrile, isobutyl alcohol, and 1,4-dioxane results of all associated samples have been qualified as estimated (J) or estimated detection limit (UJ) as listed in Table 5.

3.1.4 Calibration Verification – Acceptable with Discussion

Calibration verification standards were analyzed at the required frequency. The Work Plan criterion of percent difference values less than or equal to 25 was met, with one exception.

- The percent difference value of acrolein in the calibration verification analyzed on 10-27-04 is above Work Plan criteria at 52 percent. Since the bias is high and acrolein was not detected in the associated samples, data qualifiers are not required.

3.1.5 Blank Analyses – Acceptable with Qualifications

3.1.5.1 Method Blanks

Method blanks were analyzed at the required frequency. Except as noted below, target analytes were not detected above the method detection limits (MDLs).

- Methylene chloride was detected in the soil method blank at 1.1 µg/kg. Functional Guidelines prescribes three qualifications schemes for blank contamination: (1) associated sample concentrations greater than the action level (5 times the blank concentration) are not qualified, (2) associated sample concentrations less than the action level and greater than the reporting limit are qualified as undetected (U) at the reported value, and (3) associated sample concentrations less than the action level and less than the reporting limit are qualified as undetected (U) at the reporting limit. The associated samples have been qualified as shown in Table 5.

3.1.5.2 Field Blanks

Three trip blanks and one field blank were analyzed for volatile organics. Except as noted below, target analytes were not detected above the MDLs.

- Acetone and toluene were detected in the rinsate blank collected 10-18-04 at 4.2 and 0.14 µg/L, respectively. Only the toluene result of the associated sample (SW6004) required qualification as shown in Table 5.

3.1.6 Surrogate Analyses – Acceptable

Surrogate compounds were added to all samples, blanks, and QC samples as required. All recovery values are within the laboratory control limits as required by the Work Plan.

3.1.7 Matrix Spike/Matrix Spike Duplicate Analyses – Acceptable

MS/MSDs were analyzed at the required frequency and the recovery and RPD values are within the Work Plan criteria.

3.1.8 Laboratory Control Sample Analyses – Acceptable with Discussion

Laboratory control sample/laboratory control sample duplicates were analyzed as required. The recovery and RPD values are within the laboratory's control limits as specified in the Work Plan, with one exception.

- The acrolein recovery values in the soil LCS/LCSD are above the laboratory control limits at 144 and 150 percent, respectively. Data qualifiers are not required because the bias is high and acrolein was not detected in the associated samples.

3.1.9 Internal Standard Evaluation – Acceptable

Internal standards were added to all samples, blanks, and QC samples as required. The recovery criteria of the Work Plan and the retention time criteria of Functional Guidelines were met.

3.1.10 Laboratory Reporting Limits – Acceptable

The Work Plan reporting limit goals were met for all samples.

3.1.11 Field Duplicates – Acceptable with Qualifications

Sample SD6011 is a field duplicate of sample SD6003, and sample SD5011 is a field duplicate of sample SD5010. The Work Plan criterion for field duplicate precision is RPD value less than or equal to 35 for water samples and less than or equal to 50 for soil samples. With one exception, field duplicate precision is acceptable as presented in Table 2.

- The toluene RPD value for the duplicate analysis of sample SD6003 is above the Work Plan criterion at 137 percent. The toluene results of samples SD6003 and SD3011 have been qualified as estimated (J).

3.1.12 Overall Assessment of Data Usability

The usability of the data is based on the EPA guidance documents noted previously. Upon consideration of the information presented here; the data are acceptable. The data qualifier flags modify the usefulness of the individual values.

3.2 Semivolatile Organic Analyses

3.2.1 Holding Times – Acceptable

The samples were extracted within the required holding time of seven days from collection for water samples and 14 days from collection for soil samples. The sample extracts were analyzed within the required holding time of 40 days from extraction.

3.2.2 Instrument Tuning and Mass Calibration – Acceptable

The tuning compound decafluorotriphenylphosphine was analyzed at the required frequency and all relative abundance values are acceptable.

3.2.3 Initial Calibration – Acceptable

Initial calibrations were analyzed at the required frequency. The Work Plan criteria of RSD values less than or equal to 30 percent and relative response factors greater than 0.1 were met.

3.2.4 Calibration Verification – Acceptable with Qualifications

Calibration verification standards were analyzed at the required frequency. The Work Plan criterion of percent difference values less than or equal to 20 was met for target analytes, with the following exceptions.

- The percent difference values of aniline and 3,3'-dimethylbenzidine in the 11-2-04 calibration verification are above the Work Plan criteria at 50 and 53 percent respectively. Since the bias is low, and neither analyte was detected in the associated samples, the results have been qualified as estimated detection limit (UJ) as shown below.
- The percent difference value of 2,4-dinitrophenol in the 11-9-04 calibration verification is above the Work Plan criteria at 25 percent. Since the bias is high and 2,4-dinitrophenol was not detected in the associated samples, data qualifiers are not required.
- The percent difference values of 2,4-dinitrophenol, hexachlorocyclopentadiene, and 2,4,6-tribromophenol in the 11-10-04 calibration verification are above the Work Plan criteria at 25, 23, and 26 percent, respectively. Data qualifiers are not required for 2,4-dinitrophenol or hexachlorocyclopentadiene because the bias is high and neither analyte was not detected in the associated samples. Data qualifiers are not required for 2,4,6-trichlorophenol because it is a surrogate compound.

3.2.5 Blank Analyses – Acceptable with Discussion

3.2.5.1 Method Blanks

Method blanks were analyzed at the required frequency and target analytes were not detected above the MDLs.

3.2.5.2 Field Blanks

One field blank was analyzed for semivolatile organic compounds. Except as noted below, target analytes were not detected above the MDLs in sample Rinse Blank (J0403038-008).

- Pentachlorophenol, 2,3,4,6-tetrachlorophenol, and diethyl phthalate were detected in sample Rinse Blank at 4.5, 1.2, and 6.2 µg/L, respectively. Data qualifiers are not required because the associated sample (SW6004) is free of positive results.

3.2.6 Surrogate Analyses – Acceptable

Surrogate compounds were added to all samples, blanks, and QC samples as required. All recovery values are within the laboratory control limits as specified in the Work Plan.

3.2.7 Matrix Spike/Matrix Spike Duplicate Analyses – Acceptable with Discussion

MS/MSDs were analyzed at the required frequency. Except as noted below, all recovery and RPD values are within the laboratory control limits as specified by the Work Plan.

- The bis(2-chloroisopropyl)ether MS recovery value in the spiked analysis of sample SW6002 is above the laboratory's control limit at 88 percent. Data qualifiers are not required because the MSD recovery value is acceptable.

3.2.8 Laboratory Control Sample Analyses – Acceptable with Qualifications

Laboratory control samples were analyzed as required. The recovery and RPD values are within the laboratory's control limits, with the following exceptions.

- The bis(2-chloroisopropyl)ether, 4-chloroaniline, 2,4-dinitrophenol, fluorene, and diethyl phthalate recovery values in the J0403038 water LCS are above the laboratory control limits (values range from 88 to 129 percent). Since the bias is high, only positive results in the associated samples have been qualified as estimated (J).
- The 2,4-dinitrophenol recovery value in the J0403038 soil LCS is above the laboratory control limits at 116 percent. Data qualifiers are not required because the bias is high and positive results were not detected in the associated samples.

3.2.9 Internal Standard Evaluation – Acceptable with Discussion

Internal standards were added to all samples, blanks, and QC samples as required. Except as noted below, the recovery criteria and the retention time criteria of Functional Guidelines were met.

- The recovery of internal standard perylene-d₁₂ is above Functional Guidelines criteria in the undiluted analyses of sample SD6006. The data do not require qualification because the sample was successfully reanalyzed.
- The recovery of internal standard perylene-d₁₂ is above Functional Guidelines criteria in the original and reanalysis of sample SD6011. The data do not require qualification because the sample was successfully analyzed at a dilution.

- The recovery of internal standard perylene-d₁₂ is above Functional Guidelines criteria in the original analysis of sample SD6004 and the recovery of internal standards chrysene-d₁₂ and perylene-d₁₂ are above Functional Guidelines criteria in the reanalysis of sample SD6004. The data do not require qualification because the sample was successfully analyzed at a dilution.

3.2.10 Laboratory Reporting Limits – Acceptable

The reporting limit goals specified in the Work Plan were met for all samples.

3.2.11 Field Duplicates – Acceptable with Qualifications

Sample SD5011 is a field duplicate of sample SD5010, and sample SD6011 is a field duplicate of sample SD6003. The Work Plan criteria for field duplicate precision is RPD values less than or equal to 35 for water samples and less than or equal to 50 for soil samples. With the exceptions noted below, the field duplicate precision is acceptable as presented in Table 2.

- The acenaphthylene, pentachlorophenol, phenanthrene, anthracene, fluoranthene, pyrene, chrysene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(b)fluoranthene, indeno(1,2,3,-cd)pyrene, and benzo(g,h,i)perylene RPD values for the duplicate analysis of SD5010/SD5011 are above the Work Plan criterion (values range from 184 to 199). Positive results in both samples have been qualified as estimated (J).

3.2.12 Overall Assessment of Data Usability

The usability of the data is based on the EPA guidance documents noted previously. Upon consideration of the information presented here; the data are acceptable. The data qualifier flags modify the usefulness of the individual values.

3.3 Chlorinated Pesticide, Polychlorinated Biphenyl, Organophosphorus Pesticide, and Chlorinated Herbicide Analyses

3.3.1 Holding Times – Acceptable

The samples were extracted within the required holding time of seven days for water samples and 14 days for soil samples. The sample extracts were analyzed within the required holding time of 40 days from extraction.

3.3.2 Initial Calibration – Acceptable

Initial calibrations were analyzed at the required frequency. The Work Plan criterion of RSD values less than or equal to 25 percent or the Method 8000B (USEPA 1996) criterion of correlation coefficient greater than or equal to 0.99 were met.

3.3.3 Continuing Verification – Acceptable with Qualifications

Calibration verification standards were analyzed at the required frequency. The Work Plan criterion of percent difference values less than or equal to 20 was met on both analytical columns, with the following exceptions.

- The percent difference value of methoxychlor in the first calibration verification analyzed on 11-2-04 is above criteria at 38 percent on the DB-35 column. Data qualifiers are not required because the percent difference value is acceptable on the second analytical column.
- For the second calibration verification analyzed on 11-2-04, the percent difference values of 4,4'-DDT and methoxychlor are above criteria on the DB-XLB column at 47 and 39 percent, respectively. The percent difference values of 4,4'-DDD and 4,4'-DDT are above criteria on the DB-35 column at 57 and 37 percent, respectively. Data qualifiers are not required for methoxychlor or 4,4'-DDD because the percent difference on the other column is acceptable. Since the bias is low on both columns for 4,4'-DDT, the associated sample results have been qualified as estimated (J) or estimated detection limit (UJ).
- For the third calibration verification analyzed on 11-2-04, the percent difference values of heptachlor, aldrin, 4,4'-DDE, 4,4'-DDT, and methoxychlor are above criteria on the DB-XLB column (values range from 22 to 59 percent). The percent difference values of 4,4'-DDE and 4,4'-DDT are above criteria on the DB-35 column at 58 and 48 percent, respectively. Data qualifiers are not required for heptachlor, aldrin, or methoxychlor because the percent difference on the other column is acceptable. Data qualifiers are not required for 4,4'-DDE because the bias on the DB-XLB column is low and the bias in the DB-35 column is high. Since the bias is low on both columns for 4,4'-DDT, the associated sample results have been qualified as estimated (J) or estimated detection limit (UJ).
- For the calibration verification analyzed on 11-29-04, the percent difference values of alpha-BHC, gamma-BHC, beta-BHC, delta-BHC, heptachlor, heptachlor epoxide, gamma chlordane, alpha chlordane, endrin, endosulfan II, 4,4-DDT, endrin aldehyde, methoxychlor, endosulfan sulfate, and endrin ketone are above criteria on both columns (values range from 24 to 98 percent). In addition, the percent difference value of dieldrin is above criteria on the DB-XLB column at 24 percent and the percent difference values of endosulfan I and decachlorobiphenyl are above criteria on the DB-35 column at 26 and 22 percent, respectively. Data qualifiers are not required for dieldrin or endosulfan I because the percent difference on the other column is acceptable. Data qualifiers are not required for decachlorobiphenyl because it is a surrogate compound. Since the bias is low on both columns for alpha-BHC, gamma-BHC, beta-BHC, delta-BHC, heptachlor, heptachlor epoxide, gamma chlordane, alpha chlordane, endrin, endosulfan II, 4,4-DDT, endrin aldehyde, methoxychlor, endosulfan sulfate, and endrin ketone the associated sample results have been qualified as estimated (J) or estimated detection limit (UJ).

- Several percent difference values are above criteria for the Aroclor analyses. Data qualifiers are not required because either the percent difference values on the other analytical column is acceptable, the affected analyte is a surrogate compound, or only one peak of the four peaks used for calibration is affected.
- Several percent difference values are above criteria for the organophosphate pesticide analyses. Data qualifiers are not required because either the bias is high and the effected analytes was not detected in the associated samples, the percent difference values on the other analytical column are acceptable, or the affected analyte is a surrogate compound.

3.3.4 Blank Analyses – Acceptable

3.3.4.1 Method Blanks

Method blanks were analyzed at the required frequency and target analytes were not detected above the MDLs.

3.3.4.2 Field Blanks

Sample Rinse Blank-Soil was analyzed for chlorinated pesticides and Aroclors. Sample Rinse Blank was analyzed for chlorinated pesticides, Aroclors, organophosphate pesticides, and chlorinated herbicides. Target analytes were not detected above the MDLs in either field blank.

3.3.5 Surrogate Analyses – Acceptable

Surrogate compounds were added to all samples, blanks, and QC samples as required. The recovery values are within the laboratory control limits as specified by the Work Plan.

3.3.6 Matrix Spike/Matrix Spike Duplicate Analyses – Acceptable with Discussion

MS/MSDs were analyzed as required. Except as noted below, the recovery and RPD values are within the laboratory control limits as specified by the Work Plan.

- For the chlorinated pesticide MS/MSD analyses of sample SW6004, the MS recovery value of endosulfan sulfate is above the laboratory's control limits at 114 percent and the MS and MSD recovery values of endrin ketone are above the control limits at 130 and 109 percent. Data qualifiers are not required for endosulfan sulfate because the MSD recovery value is acceptable. Data qualifiers are not required for endrin ketone because the bias is high and endrin ketone was not detected in sample SW6004.
- Several organophosphate pesticide MS and MSD recovery values are outside the laboratory control limits. Data qualifiers are not required because the sample spiked as the MS/MSD is a non-project sample.

3.3.7 Laboratory Control Sample Analyses – Acceptable with Discussion

Laboratory control samples were analyzed as required. Except as noted below, the recovery values are within the laboratory control limits as specified in the Work Plan.

- The beta-BHC, endosulfan II, endosulfan sulfate, and endrin ketone recovery values in the chlorinated pesticide water LCS are above the laboratory control limits at 104, 110, 112, and 132 percent, respectively. Data qualifiers are not required because the bias is high and positive results were not detected in the associated samples.

3.3.8 Laboratory Reporting Limits – Acceptable with Discussion

The reporting limit goals listed in the Work Plan were met, with the following exceptions.

- The reporting limit for disulfoton in water does not meet the Work Plan target reporting limit. The laboratory reporting limit is 1.1 µg/L, which are higher than the target reporting limit of 1.0 µg/L.
- The water reporting limits for the chlorinated herbicide analyses are not adjusted for the volume extracted. The laboratory verified that this is the case and stated that the variations are minor. Data qualifiers are not required.

3.3.9 Field Duplicates – Acceptable

Sample SD6011 is a field duplicate of sample SD6003, and sample SD5011 is a field duplicate of sample SD5010. RPD values could not be calculated because positive results were not detected in the samples.

3.3.10 Overall Assessment of Data Usability

The usability of the data is based on the EPA guidance documents noted previously. Upon consideration of the information presented here; the data are acceptable. The data qualifier flags modify the usefulness of the individual values.

3.4 Metals Analyses

3.4.1 Holding Times – Acceptable

The samples were analyzed within the required holding time of 28 days for mercury in preserved water samples and 180 days for all other metals soil and preserved water samples.

3.4.2 Initial Calibration – Acceptable with Qualifications

Initial calibrations were analyzed as required. With one exception, the QC checks met method and Functional Guidelines requirements.

- The thallium recovery values in the two detection limit standards (CRI analyses) associated with SDG J0403038 were incorrectly calculated. The laboratory resubmitted corrected summary sheets.
- The arsenic recovery value in the CRI analysis associated with the water samples of SDG J0403038 is below Functional Guidelines criteria (70 to 130 percent) at 55 percent. Since the bias is low and arsenic was not detected in sample Rinse Blank, the result has been estimated detection limit (UJ).

3.4.3 Calibration Verifications – Acceptable with Qualification

Initial calibration verifications and continuing calibration verifications were analyzed at the required frequency. The Work Plan criterion of 90 to 110 percent recovery was met, with the following exceptions.

- The recovery values of mercury in the fifth, sixth, and seventh calibration verification standards associated with SDG J0403038 are below criteria at 86 percent each. Due to the potential low bias, the mercury results of the associated samples have been qualified as estimated (J) or estimated detection limit (UJ).

3.4.4 Blank Analyses – Acceptable with Qualifications

3.4.4.1 Instrument and Method Blanks

Instrument and method blanks were analyzed at the required frequency. Except as noted below, target analytes were not detected above the MDLs.

- Chromium was detected in the method blank associated with SDG J0402968 at 0.192 mg/kg. Data qualifiers are not required because the associated sample results are greater than five times the blank concentration.
- Barium and tin were detected in the soil method blank associated with SDG J0403038 at -0.233 and 0.478 mg/kg, respectively. Barium has a negative response greater than the absolute value of the reporting limit. Data qualifiers are not required for barium because the barium concentrations in the associated samples are greater than 10 times the reporting limit. The tin results in the associated samples have been qualified as shown below.
- Chromium and lead were detected in the water method blank associated with SDG J0403038 at 0.308 and 0.029 µg/L, respectively. Functional Guidelines requires qualifying associated sample results that are less than five times the blank concentration as undetected (U) at the reported value. The associated sample was qualified as shown below.
- Antimony, barium, cobalt, thallium, and tin were detected in the initial calibration blank associated with the soil analyses of SDG J0403038 (values range from 0.028 to 0.325 µg/L). The associated sample was qualified as shown below.

- Antimony, barium, thallium, and tin were detected in the calibration blanks associated with the soil analyses of SDG J0403038 (values range from -0.990 to 0.241 µg/L). Barium has a negative response greater than the absolute value of the reporting limit. Data qualifiers are not required for barium because the barium concentrations in the associated samples are greater than 10 times the reporting limit. The associated sample was qualified as in Table 5.
- Barium, lead, and antimony were detected in the calibration blanks associated with the water analyses of SDG J0403038 (values range from 0.090 to 0.479 µg/L). Data qualifiers are not required because either the sample results are greater than five times the blank concentration or the samples results are nondetected.

3.4.4.2 Field Blanks

Sample Rinse Blank was analyzed for metals. Except as noted below, target analytes were not detected above the MDLs after method blank qualifying.

- Barium, chromium, cobalt, copper, nickel, and zinc were detected in the Rinse Blank (values range from 0.050 to 19.9 µg/L). Functional Guidelines requires qualifying associated sample results that are less than five times the blank concentration as undetected (U) at the reported value. The qualified data are listed in Table 5.

3.4.5 ICP Interference Check – Acceptable

ICP interference check samples (ICSSs) were analyzed as required. All percent recovery values are within Functional Guidelines criteria.

3.4.6 Duplicate Sample Analysis – Acceptable with Discussion

Duplicate sample analyses were performed at the required frequency. With the following exception, the RPD values are within the Work Plan criteria of less than 35 percent.

- The silver RPD value for the duplicate analysis associated with SDG J0403038 is above criteria at 54 percent. Data qualifiers are not required because a non-project sample was analyzed as the duplicate.

3.4.7 Spiked Sample Analyses – Acceptable with Discussion

Matrix spike analyses were performed at the required frequency and the recovery values are within the Work Plan criteria of 75 to 125 percent, except as noted below.

- For SDG J0403038, the antimony and silver recovery values in the soil MS are below criteria. Data qualifiers are not required because a non-project sample was analyzed as the MS and the acceptable LCS demonstrates the analytical system is in-control.
- For SDG J0403038, the tin recovery value in the water MS is below criteria at 72.5 percent. Data qualifiers are not required because a non-project sample was

analyzed as the MS and the acceptable LCS demonstrates the analytical system is in-control.

3.4.8 Laboratory Control Sample Analyses – Acceptable

Laboratory control samples were analyzed as required. The percent recovery values are within the Work Plan criteria of 80 to 120 percent.

3.4.9 ICP Serial Dilution Analysis – Acceptable with Discussion

Serial dilutions were performed as required. The Functional Guidelines criteria of percent difference values less than 10 percent for results greater than 50 times the MDL were met, with one exception.

- The percent difference value of barium in the serial dilution analysis associated with SDG J0403038 is above Functional Guidelines criteria at 11 percent. Data qualifiers are not required because a non-project sample was serially diluted.

3.4.10 Laboratory Reporting Limits – Acceptable

The reporting limits specified in the Work Plan were met.

3.4.11 Field Duplicates – Acceptable

Sample SD5011 is a field duplicate of sample SD5010, and sample SD6011 is a field duplicate of sample SD6003. The RPD values are within the Work Plan criterion of less than 50 for soil samples as shown in Table 2.

3.4.12 Overall Assessment of Data Usability

The usability of the data is based on the EPA guidance documents noted previously. Upon consideration of the information presented here; the data are acceptable. The data qualifier flags modify the usefulness of the individual values.

3.5 Miscellaneous Analyses – Total Organic Carbon, Hexavalent Chromium, Cyanide, pH, and Grain Size

3.5.1 Holding Times – Acceptable with Qualifications

The samples were analyzed within the 14-day holding time for preserved cyanide samples, the 28-day holding time for preserved total organic carbon (TOC) samples, the 24-hour holding time for hexavalent chromium, and the seven day holding time for pH, with the following exceptions.

- The pH analysis of the soil samples in SDGs J0402968 and J0403038 were preformed past the holding time. The results have been qualified as estimated (J).
- The hexavalent chromium analyses of water samples in SDG J0403038 were preformed past the holding time. The results have been qualified as estimated (J) or estimated detection limit (UJ).

3.5.2 Initial Calibration and Calibration Verification – Discussion

Initial calibrations and calibration verifications could not be evaluated because these data are not present in the data packages. Data qualifiers are not required since it is assumed the laboratory followed good laboratory practices in analyzing the samples.

3.5.3 Blank Analyses – Acceptable with Discussion

3.5.3.1 Method Blanks

Except as noted below, method blanks and calibration blanks were analyzed at the required frequency and target analytes were not detected above the MDLs.

- Method blanks were not analyzed for TOC in soil. Data qualifiers are not recommended.

3.5.3.2 Field Blanks

The rinse blank collected 10-18-04 contained total cyanide at 0.0047 mg/L. Data qualifiers are not required because either the associated samples are free of total cyanide or their concentrations are greater than five times the field blank concentration.

3.5.4 Laboratory Control Sample Analyses – Acceptable

Laboratory control samples were reported at the required frequency. The percent recovery values are within the laboratory's control limits.

3.5.5 Duplicate Sample Analyses – Acceptable

Sample duplicates were analyzed at the required frequency and the RPD values are within laboratory's control limits.

3.5.6 Matrix Spike Analyses – Acceptable

Matrix spike analyses were performed at the required frequency. The percent recovery values are within the laboratory's control limits.

3.5.7 Laboratory Reporting Limits – Acceptable

Reporting limits goals are not specified in the Work Plan for general chemistry parameters. The reporting limits used by the laboratory are reasonable for the analytical methods used.

3.5.8 Field Duplicates – Acceptable

Sample SD5011 is a field duplicate of sample SD5010 and sample SD6011 is a field duplicate of sample SD6003. The precision of the field duplicates is acceptable as shown by the low RPD values listed in Table 2.

3.5.9 Overall Assessment of Data Usability

The usability of the data is based on the EPA guidance documents noted previously. Upon consideration of the information presented here; the data are acceptable. The data qualifier flags modify the usefulness of the individual values.

4.0 Cursory Validation

4.1 Volatile Organic Analyses

4.1.1 Holding Times – Acceptable

The samples were analyzed within the required holding time of 14 days for soil samples and preserved water samples.

4.1.2 Blank Analyses – Acceptable with Qualifications

4.1.2.1 Method Blanks

Method blanks were analyzed at the required frequency. With two exceptions, target analytes were not detected above the MDLs.

- Methylene chloride and toluene were detected in the 10-20-04 soil method blank at 5.5 and 0.88 µg/kg, respectively. Data qualifiers are not required because neither methylene chloride nor toluene were detected in the associated sample.
- Methylene chloride was detected in the 10-27-04 soil method blank at 1.1 µg/kg. Functional Guidelines prescribes three qualifications schemes for blank contamination, (1) associated sample concentrations greater than the action level (5 times the blank concentration) are not qualified, (2) associated sample concentrations less than the action level and greater than the reporting limit are qualified as undetected (U) at the reported value, and (3) associated sample concentrations less than the action level and less than the reporting limit are qualified as undetected (U) at the reporting limit. Three samples contained levels that are greater than the MDL and less than the action level as shown in Table 5.

4.1.2.2 Field Blanks

Four trip blanks are associated with the samples. Reportable levels of target analytes were detected in two of the trip blanks as discussed below.

- Toluene was detected in the trip blank associated with SDG J0402994 at 0.25 µg/L. Functional Guidelines prescribes three qualifications schemes for blank contamination, (1) associated sample concentrations greater than the action level (5 times the blank concentration) are not qualified, (2) associated sample concentrations less than the action level and greater than the reporting limit are qualified as undetected (U) at the reported value, and (3) associated sample concentrations less than the action level and less than the reporting limit are

qualified as undetected (U) at the reporting limit. Sample SW6001 was qualified as shown in Table 5.

- Acetone was detected in the trip blank associated with SDG J0403074 at 8.7 µg/L. Samples SW6005 and SW6007 were qualified as shown in Table 5.

4.1.3 Surrogate Analyses – Acceptable

Surrogate compounds were added to all samples, blanks, and QC samples as required. All recovery values are within the laboratory's control limits.

4.1.4 Matrix Spike/Matrix Spike Duplicate Analyses – Acceptable with Qualifications

MS/MSDs were analyzed at required frequency. Except as noted below, the percent recovery and relative percent difference (RPD) values are within the laboratory's control limits.

- For the spiked analysis of sample SD6009, the MS and MSD recovery values of vinyl acetate are below the laboratory control limits at 3 and 4 percent, the MS and MSD recovery values of isobutyl alcohol are below the laboratory control limits at 54 and 59 percent, the MS and MSD recovery values of ethyl methacrylate are below the laboratory control limits at 53 and 59 percent, and the MS recovery value of propionitrile is below the laboratory control limit at 70 percent. Due to the extremely low recovery of vinyl acetate, the nondetected result of sample SD6009 has been rejected (qualified R). The isobutyl alcohol and ethyl methacrylate results of sample SD6009 has been qualified as estimated detection limit (UJ). Data qualifiers are not required for propionitrile because the MSD recovery is acceptable.

4.1.5 Laboratory Control Sample Analyses – Acceptable with Discussion

Laboratory control samples or LCS/LCSDs were analyzed as required. The recovery and RPD values are within the laboratory's control limits.

- The acrolein recovery value in the LCS associated with SDG J0402994 is above the laboratory control limits at 138 percent. Data qualifiers are not required because the LCSD recovery value is acceptable.
- The acrolein recovery values in the LCS and LCSD associated with SDG J0403074 are above the laboratory control limits at 144 and 150 percent, respectively. Data qualifiers are not required because the bias is high and acrolein was not detected in the associated samples.

4.1.6 Laboratory Reporting Limits – Acceptable with Discussion

The project specific reporting limits listed in the Work Plan were met, with one exception.

- The acrylonitrile MDL is 10 µg/L, which is higher than the Work Plan reporting limit goal of 5 µg/L.

4.1.7 Field Duplicates – Acceptable

Two field duplicates are associated with these samples. The Work Plan criterion for field duplicate precision of soil samples is RPD value less than 50 percent and less than 35 percent for water samples. Field duplicate precision is acceptable as shown by the low RPD values listed in Table 2.

4.1.8 Overall Assessment of Data Usability

The usability of the data is based on the EPA guidance documents noted previously. Upon consideration of the information presented here, the data are acceptable. The data qualifier flags modify the usefulness of the individual values. Rejected results are not useable for any purpose.

4.2 Semivolatile Organic Analyses

4.2.1 Holding Times – Acceptable

The sample was extracted within the required holding time of seven days from collection for water samples and 14 days from collection for soil samples. The sample extracts were analyzed within the required holding time of 40 days from extraction.

4.2.2 Blank Analyses – Acceptable with Discussion

4.2.2.1 Method Blanks

Method blanks were analyzed at the required frequency. With two exceptions, target analytes were not detected above the MDLs.

- In the tentatively identified compound analysis of the soil method blank associated with SDG J0402994, 1,1,2-trichloroethane and 1,1,2,2-tetrachloroethane were detected. Data qualifiers are not required because these analytes were detected in the associated sample (SD6001).

4.2.2.2 Field Blanks

The field blanks were not analyzed for semivolatile organic analyses.

4.2.3 Surrogate Analyses – Acceptable

Surrogate compounds were added to all samples, blanks, and QC samples as required and all recovery values are within the laboratory's control limits.

4.2.4 Matrix Spike/Matrix Spike Duplicate Analyses – Acceptable with Discussion

MS/MSDs were analyzed as required. Except as noted below, the percent recovery and RPD values for target analytes are within the laboratory's control limits.

- The 3,3'-dichlorobenzidine MS recovery value in the spiked analysis of sample SW6006 is below the laboratory's control limit at 18 percent. Data qualifiers are not required because the MSD recovery value is acceptable.

4.2.5 Laboratory Control Sample Analyses – Acceptable with Qualifications

Laboratory control samples were analyzed as required. The percent recovery values are within the laboratory's control limits, with the following exceptions.

- The 4-methylphenol and benzo(b)fluoranthene recovery values in the J0402994 water LCS are above the laboratory's control limits at 106 and 107 percent, respectively. Data qualifiers are not required because the bias is high and neither analyte was detected in the associated samples.
- The 2,4-dinitrophenol recovery value in the J0402994 soil LCS is above the laboratory's control limits at 116 percent. Data qualifiers are not required because the bias is high and 2,4-dinitrophenol was not detected in the associated samples.
- The bis(2-chloroisopropyl)ether, benzyl alcohol, 4-methylphenol, 2,4,5-trichlorophenol, fluorene, and 4-chlorophenyl phenyl ether recovery values in the J0403074 water LCS are above the laboratory control limits (values range from 89 to 117 percent). Since the bias is high, only positive results in the associated samples have been qualified as estimated (J).

4.2.6 Laboratory Reporting Limits – Acceptable

The project specific reporting limits specified in the Work Plan were met.

4.2.7 Tentatively Identified Compounds – Acceptable with Qualification

Tentatively identified compounds (TICs) were reported for the soil samples. The TICs were reported because the laboratory's Method 8141 soil analysis is not properly calibrated for famphur, thionazin, or o,o,o-triethyl phosphorothioate. None of these target analytes were reported in the TIC results of the soil samples. The TIC raw data (chromatograms and mass spectra) were reviewed and the mass spectra of the TICs were compared to the reference spectra. As described below, three TIC identifications were incorrectly made and have been corrected. As specified in Functional Guidelines, all TIC results have been qualified as tentatively identified with an estimated concentration (NJ).

- Three TIC identifications of sample SD6001 were incorrectly made. They have been corrected as shown in Table 5.

4.2.8 Field Duplicates – Acceptable with Qualifications

Two field duplicates (SD5010/SD5011 and SW6005/SW6007) are associated with these samples. The Work Plan criterion for field duplicate precision of soil samples is RPD value less than 50 percent. With the exceptions noted below, field duplicate precision is acceptable.

- The acenaphthylene, pentachlorophenol, phenanthrene, anthracene, fluoranthene, pyrene, chrysene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(b)fluoranthene, indeno(1,2,3,-cd)pyrene, and benzo(g,h,i)perylene RPD values for the duplicate analysis of SD5010/SD5011 are above the Work Plan criterion (values range from 184 to 199). Positive results in both samples have been qualified as estimated (J).

4.2.9 Overall Assessment of Data Usability

The usability of the data is based on the EPA guidance documents noted previously. Upon consideration of the information presented here, the data are acceptable. The data qualifier flags modify the usefulness of the individual values.

4.3 Chlorinated Pesticide, Polychlorinated Biphenyl, Organophosphorus Pesticide, and Chlorinated Herbicide Analyses

4.3.1 Holding Times – Acceptable

The sample was extracted within the required holding time of seven days from collection for water samples and 14 days from collection for soil samples. The extracts were analyzed within the required holding time of 40 days from extraction.

4.3.2 Blank Analyses – Acceptable

4.3.2.1 Method Blanks

Method blanks were analyzed at the required frequency and target analytes were not detected above the MDLs.

4.3.2.2 Field Blanks

Field blanks are not associated with this sample set.

4.3.3 Surrogate Analyses – Acceptable with Qualifications

Surrogate compounds were added to all samples, blanks, and QC samples as required. Except as noted below, the recovery values are within the laboratory's control limits.

- The decachlorobiphenyl (DCBP) surrogate recovery value in the chlorinated pesticide analysis of sample SW6006 is below the laboratory's control limits at 11 percent. Data qualifiers are not required because the recovery of the second surrogate (tetrachlorometaxylene) is acceptable.
- The DCBP surrogate recovery value in the PCB Aroclor analysis of sample SW6006 is below the laboratory's control limits at 15 percent. Due to the low bias, the results of sample SW6006 have been qualified as estimated (J) or estimated detection limit (UJ) as shown in Table 5.
- The tributylphosphate and triphenylphosphate surrogate recovery values in the organophosphorus pesticide analysis of sample SW6006 are below the laboratory's control limits at 8 and 11 percent, respectively. Functional Guidelines requires rejecting nondetected results or estimating positive results associated with a recovery below 10 percent. Therefore, the organophosphorus pesticide results have been qualified as rejected (R) as listed in Table 5.

4.3.4 Matrix Spike/Matrix Spike Duplicate Analyses – Acceptable with Qualifications

Except as noted below, MS/MSDs were analyzed as required and the percent recovery and RPD values are within the laboratory's control limits.

- The laboratory did not report water MS/MSD results for the chlorinated herbicides due to inadequate sample volume supplied to the laboratory. Data qualifiers are not required.
- For the chlorinated pesticide analysis of sample SW6006, the beta-BHC MSD recovery value is above the laboratory's control limits at 169 percent, and the aldrin MS and MSD recovery values are below the laboratory control limits at 14 and 17 percent. Data qualifiers are not required for beta-BHC because the MS recovery is acceptable. The undetected aldrin result of sample SW6006 has been qualified as estimated detection limit (UJ).
- For the MS/MSD analyses of sample SW6006, the RPD value of beta-BHC is above the laboratory's control limit at 90 percent. Data qualifiers are not required because beta-BHC was not detected in the spiked sample.
- For the chlorinated pesticide analysis of sample SD6009, the endrin ketone MS recovery value is above the laboratory's control limits at 87 percent. Data qualifiers are not required because the MSD recovery is acceptable.
- For the organophosphorus pesticide analysis of sample SD6010, the disulfoton MS and MSD recovery values are above the laboratory's control limits at 34 and 31 percent, the phorate MSD recovery value is below the laboratory control limits at 41 percent, the chlorpyrifos MSD recovery value is below the laboratory control limits at 52 percent, and the dimethoate MSD recovery value is below the

laboratory control limits at 52 percent. The undetected disulfoton result of sample SD6010 has been qualified as estimated detection limit (UJ). Data qualifiers are not required for phorate, chlorpyrifos, or dimethoate because a pattern of bias was not observed.

4.3.5 Laboratory Control Sample Analyses – Acceptable with Discussion

Laboratory control samples or LCS/LCSDs were analyzed as required. With the exceptions listed below, all percent recovery and RPD values are within the laboratory's control limits.

- The endrin ketone LCSD recovery value in the water LCS/LCSD analyzed with SDG J0402994 is above the laboratory control limits at 104 percent. Data qualifiers are not required because the LCS recovery is acceptable.
- The beta-BHC, endosulfan II, endosulfan sulfate, and endrin ketone recovery values in the water LCS associated with SDG J0403074 are above the laboratory control limits (values range from 104 to 132 percent). Data qualifiers are not required because the bias is high and positive results were not detected in the associated samples.
- The endrin ketone recovery value in the soil LCS analyzed with SDG J0403074 is above the laboratory control limits at 96 percent. Data qualifiers are not required because the bias is high and endrin ketone was not detected in the associated samples.

4.3.6 Laboratory Reporting Limits – Acceptable

The project required reporting limits listed in the Work Plan were met for samples that were analyzed undiluted.

4.3.7 Field Duplicates – Acceptable

One field duplicate (SW6005/SW6007) is associated with these samples. The Work Plan criterion for field duplicate precision of water samples is RPD value less than 35 percent. The precision of the field duplicate is acceptable as shown in Table 2.

4.3.8 Overall Assessment of Data Usability

The usability of the data is based on the EPA guidance documents noted previously. Upon consideration of the information presented here, the data are acceptable. The data qualifier flags modify the usefulness of the individual values. Reject values are not useable for any purpose.

4.4 Metals Analyses

4.4.1 Holding Times – Acceptable

The samples were analyzed within the required holding times of 28 days for mercury and 180 days for all other metals.

4.4.2 Blank Analyses – Acceptable with Qualifications

4.4.2.1 Method Blanks

Method blanks were analyzed at the required frequency. Target analytes were not detected above the reporting limits, with the following exceptions.

- Arsenic, chromium, lead, silver, and tin were detected in the J0402994 soil method blank. Functional Guidelines requires qualifying associated sample results that are less than five times the blank concentration as undetected (U) at the reported value. Sample SD6010 was qualified as shown in Table 5.
- Chromium and copper were detected in the J0402994 water method blank at 0.612 and 0.070 µg/L, respectively. Data qualifiers are not required because the chromium and copper concentrations in the associated samples are greater than five times the method blank concentration.
- Barium and tin were detected in the J0403074 soil method blank. Two samples were qualified as shown in Table 5.
- Chromium and lead were detected in the J0403074 water method blank at 0.308 and 0.029 µg/L, respectively. Data qualifiers are not required because the chromium and lead concentrations in the associated samples are greater than five times the method blank concentration.

4.4.2.2 Field Blanks

Field blanks are not associated with this sample set.

4.4.3 Duplicate Sample Analyses – Acceptable with Discussion

The laboratory duplicates were analyzed as required. With one exception, the RPD values are within Functional Guidelines criteria.

- The mercury RPD value for the duplicate analysis of sample SD6009 is above criteria at 56 percent. Data qualifiers are not required because the RPD value of the MS/MSD analyzed on this sample is acceptable.

4.4.4 Matrix Spike Analyses – Acceptable with Qualifications

Matrix spike analyses were reported at the required frequency. The recovery values are within Functional Guidelines criteria of 75 to 125 percent, with the following exceptions.

- The antimony soil MS recovery value is below criteria at 59.8 percent. Data qualifiers are not required because a non-project sample was analyzed as the MS/MSD and the acceptable LCS demonstrates the analytical system is in-control.
- The MS and MSD recovery values of antimony and the silver MSD recovery value in the spiked analysis of sample SD6009 are below criteria at 59.9, 56.5, and 51.0 percent, respectively. The antimony result of sample SD6009 has been qualified as estimated (J). Data qualifiers are not required for silver because the MS recovery value is acceptable.

4.4.5 Laboratory Control Sample Analyses – Acceptable with Discussion

Laboratory control samples were reported at the required frequency. All percent recovery values are within Functional Guidelines criteria.

- The mercury recovery value was incorrectly calculated for the J0403074 soil LCS. The laboratory resubmitted the summary sheet with the correct recovery value.

4.4.6 Laboratory Reporting Limits – Acceptable

The project specific reporting limits of the Work Plan were met.

4.4.7 Field Duplicates – Acceptable with Qualifications

Two field duplicates (SW6005/SW6007 and SD5010/SD5011) were analyzed for metals. The Work Plan criterion for field duplicate precision of water samples is RPD value less than 35 percent for water samples and less than or equal to 50 for soil samples. With two exceptions, the precision of the field duplicate is acceptable.

- The RPD values of tin and zinc for field duplicate pair SW6005/SW6007 are above the Work Plan criterion at 43 and 36 percent, respectively. The tin and zinc results of both samples have been qualified as estimated (J).

4.4.8 Overall Assessment of Data Usability

The usability of the data is based on the EPA guidance documents noted previously. Upon consideration of the information presented here, the data are acceptable. The data qualifier flags modify the usefulness of the individual values.

4.5 Miscellaneous Analyses – Cyanide, Total Organic Carbon, Hexavalent Chromium, pH, and Grain Size

4.5.1 Holding Times – Acceptable with Qualifications

The samples were analyzed within the 14-day holding time for preserved cyanide samples, the 28-day holding time for preserved total organic carbon (TOC) samples, the

24-hour holding time for hexavalent chromium, and the seven day holding time for pH, with the following exceptions.

- The pH analysis of samples SD5011, SD5012, and SD6001 were performed past the holding time. The results have been qualified as estimated (J).
- The hexavalent chromium analysis of samples SW6006, SW6005, and SW6007 were performed past the holding time. The results have been qualified as estimated (J) or estimated detection limit (UJ).
- The TOC analysis of samples SD6010, SD6009, and SD6008 were performed past the holding time. The results have been qualified as estimated (J).

4.5.2 Blank Analyses – Acceptable

4.5.2.1 Method Blanks

Method blanks were analyzed at the required frequency and target analytes were not detected above the MDLs.

4.5.2.2 Field Blanks

Field blanks are not associated with this sample set.

4.5.3 Duplicate Sample Analyses – Acceptable with Discussion

Laboratory duplicates were analyzed at the required frequency, with one exception. All RPD values are within laboratory's control limits.

- The laboratory did not report duplicate results for cyanide. The analytical method does not require the analysis of laboratory duplicates; however, the Work Plan specified one duplicate for every 20 samples. Data qualifiers are not required.

4.5.4 Matrix Spike Analyses – Acceptable with Qualifications

MS/MSDs were analyzed as required. With one exception, the recovery values are within the Work Plan criteria of 75 to 125 percent.

- The cyanide recovery value in the MS analysis of sample SW6006 is below the Work Plan criteria at 40 percent. Due to the low bias, the cyanide result of sample SW6006 has been qualified estimated (J).

4.5.5 Laboratory Control Sample Analyses – Acceptable

Laboratory control samples were reported at the required frequency. All percent recovery values are within the Work Plan criteria or laboratory's control limits as appropriate.

4.5.6 Laboratory Reporting Limits – Acceptable

Project specific reporting limits were not required for inorganic analyses. The reporting limits used by the laboratory are reasonable for the analytical methods employed.

4.5.7 Field Duplicates – Acceptable

Two field duplicate pairs (SW6005/SW6007 and SD5010/SD5011) were analyzed for inorganic parameters. The Work Plan criterion for field duplicate precision of water samples is RPD value less than 35 percent for water samples and less than or equal to 50 for soil samples. The precision of the field duplicates is acceptable.

4.5.8 Overall Assessment of Data Usability

The usability of the data is based on the EPA guidance documents noted previously. Upon consideration of the information presented here, the data are acceptable. The data qualifier flags modify the usefulness of the individual values.

5.0 Data Qualifier Definitions

5.1 Inorganic Data Qualifiers

The following data validation qualifiers were used in the review of this data set. These qualifiers are from the *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*.

- U The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
- J The associated value is an estimated quantity.
- UJ The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
- R The data are unusable. (Note: Analyte may or may not be present)

5.2 Organic Data Qualifiers

The following data validation qualifiers were used in the review of this data set. These qualifiers are from the *Contract Laboratory Program National Functional Guidelines for Organic Data Review*.

- U The analyte was analyzed for but not detected above the reported sample quantitation limit.
- J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

- UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
- N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a “tentative identification”.
- NJ The analysis indicates the presence of an analyte that has been “tentatively identified” and the associated numerical value represents its approximate concentration.
- R The sample results are rejected due to serious deficiencies in the ability to analyze the samples and meet quality control criteria. The presence or absence of the analyte cannot be verified.

6.0 References

ASTM. 1989. Annual book of ASTM standards. Volume 04.08. American Society for Testing and Materials, Philadelphia, PA.

Exponent. 1999. Appendix E Quality Assurance Project Plan, RCRA Facility Investigation Treated Wood Products Plant Wiggins, Mississippi Work Plan. Prepared for International Paper, Memphis, Tennessee. Prepared by Exponent, Bellevue, Washington. August 1999.

Premier. 2004. Corrective Measures Study Work Plan International Paper Company Treated Wood Products Plant, Wiggins, Mississippi. Prepared for International Paper Memphis Tennessee. Prepared by Premier Environmental Services, Inc. Seattle, Washington. June 2004.

USEPA. 1994. Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. United States Environmental Protection Agency. Office of Solid Waste and Emergency Response. February 1994.

USEPA. 1996. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846) Third Edition, Updates I, II, IIA, IIB, and III. United States Environmental Protection Agency. Office of Solid Waste. December 1996.

USEPA. 1999. Contract Laboratory Program National Functional Guidelines for Organic Data Review. U.S. Environmental Protection Agency Office of Emergency and Remedial Response. EPA540/R-99/008. October 1999.

Table 1—Sample Data Reviewed

Sample ID	Laboratory ID	Validation Level	Benzene ^a	SVOA SIM ^b	As & Cr ^c	VOA ^d	SVOA ^e	Appendix IX ^f	Metals ^g	Miscellaneous ^h
SD5001	J0402968-001	Level III	X	X	X					X
SD5002	J0402968-002	Level III	X	X	X					X
SD5003	J0402968-003	Level III	X	X	X					X
SD5004	J0402968-004	Level III	X	X	X					X
SD5005	J0402968-005	Level III	X	X	X					X
SD5006	J0402968-006	Level III	X	X	X					X
SD5007	J0402968-007	Level III	X	X	X					X
SD5008	J0402968-008	Level III	X	X	X					X
SD5009	J0402968-009	Level III	X	X	X					X
SD5010	J0402968-010	Level III	X	X	X					X
SD5011	J0402994-001	Cursory	X	X	X					X
SD5012	J0402994-002	Cursory	X	X	X					X
SW6001	J0402994-003	Cursory				X	X	X	X	X
SD6001	J0402994-004	Cursory				X	X	X	X	X
Trip Blank	J0402994-005	Cursory				X				
SW6002	J0403038-001	Level III				X	X	X	X	X
SD6002	J0403038-002	Level III				X	X	X	X	X
Rinse Blank-Soil	J0403038-003	Level III						X		
Trip Blank	J0403038-004	Level III				X				
SD6003	J0403038-005	Level III				X	X	X	X	X
SD6005	J0403038-006	Level III				X	X	X	X	X
SD6011	J0403038-007	Level III				X	X	X	X	X
Rinse Blank	J0403038-008	Level III				X	X	X	X	X
SW6004	J0403038-009	Level III				X	X	X	X	X
SD6004	J0403038-010	Level III				X	X	X	X	X
SW6003	J0403038-011	Level III				X	X	X	X	X
Trip Blank	J0403038-012	Level III				X				
SD6006	J0403038-013	Level III				X	X	X	X	X
SD6007	J0403038-014	Level III				X	X	X	X	X
Soil Rinse Blank	J0403038-015	Level III								
Trip Blank	J0403038-016	Level III				X				
SW6006	J0403074-001	Cursory				X	X	X	X	X
SD6010	J0403074-002	Cursory				X	X	X	X	X
Trip Blank	J0403074-003	Cursory				X				
SW6005	J0403074-004	Cursory				X	X	X	X	X

Quality Assurance Review
Preliminary Corrective Measures Study, Treated Wood Products Plant, Wiggins, Mississippi

Sample ID	Laboratory ID	Validation Level	Benzene ^a	SVOA SIM ^b	As & Cr ^c	VOA ^d	SVOA ^e	Appendix IX ^f	Metals ^g	Miscellaneous ^h
SW6007	J0403074-005	Cursory				X	X	X	X	X
Trip Blank	J0403074-006	Cursory				X				
SD6009	J0403074-007	Cursory				X	X	X	X	X
SD6008	J0403074-008	Cursory				X	X	X	X	X
Trip Blank	J0403074-009	Cursory				X	X	X	X	X

^a Benzene by Method 8260B (USEPA 1996)

^b Pentachlorophenol and polycyclic aromatic hydrocarbons (PAHs) by Method 3550B/8270C (USEPA 1996) selected ion monitoring (SIM)

^c Arsenic and chromium by Method 6020 (USEPA 1996)

^d Appendix IX chlorinated pesticides by Method 3510C/8081A, polychlorinated biphenyls by Method 3510C/8082A, organophosphorus pesticides by Method 3535/8141A, and chlorinated herbicides by Method 8151

^e Volatile organic compounds by Method 8260B (USEPA 1996)

^f Semivolatile organic compounds by Method 3510C/8270C (USEPA 1996)

^g Total and dissolved antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, nickel, selenium, silver, thallium, tin, vanadium, and zinc by Method 6020, and total and dissolved mercury by Method 7470/7471 (USEPA 1996)

^h Total organic carbon (TOC) by Method SID-S3, pH by Method 9045C, Cyanide by Method 9012A (USEPA 1996), hexavalent chromium by Method 7196A (USEPA 1996), and grain size by Method D-422 (ASTM 1989)

Table 2—Field Duplicate Precision – Water Samples

Analyte	Sample ID SW6005	Duplicate ID SW6007	RPD^a
Toluene	0.42	0.35	18
2,4,5-TP	<0.062	0.066	NC
Antimony	0.342	< 0.150	NC
Arsenic	3.67	3.30	11
Barium	41.8	41.4	1.0
Cobalt	0.876	0.778	12
Copper	4.40	3.30	28
Lead	2.11	2.08	1.4
Nickel	1.18	1.30	9.7
Silver	< 0.039	0.052	NC
Tin	0.194	0.301	43
Vanadium	2.35	2.22	5.7
Zinc	31.5	45.2	36

Volatile organic, chlorinated herbicides, and metals results are in µg/L

^a Relative percent difference

^b Analyte not detected above the associated detection limit

^c Not calculatable

Table 3—Field Duplicate Precision – Soil Samples

Analyte	Sample ID SD5010	Duplicate ID SD5011	RPD^a
Acenaphthylene	90	3.7	184
Pentachlorophenol	5400	110	192
Phenanthrene	4400	7.5	199
Anthracene	280	7.9	189
Fluoranthene	20,000	41	199
Pyrene	14,000	46	199
Chrysene	4300	34	197
Benzo(a)anthracene	3300	22	197
Benzo(b)fluoranthene	4600	54	195
Benzo(k)fluoranthene	680	17	190
Benzo(a)pyrene	1000	13	195
Indeno(1,2,3-cd)pyrene	670	16	191
Benzo(g,h,i)perylene	430	11	190
Arsenic	18.7	18.0	3.8
Chromium	47.4	36.5	26
Total organic carbon	7800	6200	23
pH	5.9	6.8	14
Medium sand	2.6	2.3	12
Fine sand	61.6	63.0	2.2
Silt	8.1	6.1	28
Clay	48.3	47.3	2.1
Medium sand	15.1	16.1	6.4

Semivolatile organic compound results are in µg/kg; metals and total organic carbon results are in mg/kg; pH results are in pH units; and grain size results is in percent

^a Relative percent difference

^b Analyte not detected above the associated detection limit

^c Not calculatable

Table 4—Field Duplicate Precision – Sediment Samples

Analyte	Sample ID SD6003	Duplicate ID SD6011	RPD^a
Acetone	40	29	32
Methyl ethyl ketone	6.3	4.2	40
Toluene	29	5.4	137
Pentachlorophenol	84	<35	NC
Phenanthrene	32	30	6.4
Fluoranthene	80	73	9.2
Pyrene	42	45	6.9
Bis(2-ethylhexyl)phthalate	56	66	16
Arsenic	1.10	1.34	20
Barium	22.0	21.9	0.5
Chromium	6.67	6.71	0.6
Cobalt	0.839	0.843	0.5
Copper	3.49	3.95	12
Lead	6.83	7.95	15
Mercury	0.027	0.031	14
Nickel	1.98	1.96	1.0
Silver	0.030	0.033	9.5
Thallium	0.076	0.072	5.4
Tin	1.44	1.49	3.4
Vanadium	10.4	11.3	8.3
Zinc	11.8	13.7	15
Antimony	< 0.077	0.109	NC
Total organic carbon	14,000	11,000	24
pH	6.2	6.3	1.6
Course sand	7.5	6.6	13
Medium sand	61.5	62.4	1.5
Fine sand	12.6	13.3	5.4
Silt	31.2	30.3	2.9
Clay	10.9	7.9	32

Volatile organic and semivolatile organic results are in µg/kg; metals and total organic carbon results are in mg/kg; pH results are in pH units; and grain size results is in percent

^a Relative percent difference

^b Analyte not detected above the associated detection limit

^c Not calculatable

Table 5—Summary of Qualified Data

Sample ID	Analyte	Qualification	Reason for Qualification
SW6002	Acrolein	UJ	Average RRF below 0.1
SW6002	Acetone	J	Average RRF below 0.1
SW6002	Acetonitrile	UJ	Average RRF below 0.1
SW6002	acrylonitrile	UJ	Average RRF below 0.1
SW6002	propionitrile	UJ	Average RRF below 0.1
SW6002	isobutyl alcohol	UJ	Average RRF below 0.1
SW6002	1,4-dioxane	UJ	Average RRF below 0.1
Trip Blank (10-15-04)	Acrolein	UJ	Average RRF below 0.1
Trip Blank (10-15-04)	Acetone	UJ	Average RRF below 0.1
Trip Blank (10-15-04)	Acetonitrile	UJ	Average RRF below 0.1
Trip Blank (10-15-04)	acrylonitrile	UJ	Average RRF below 0.1
Trip Blank (10-15-04)	propionitrile	UJ	Average RRF below 0.1
Trip Blank (10-15-04)	isobutyl alcohol	UJ	Average RRF below 0.1
Trip Blank (10-15-04)	1,4-dioxane	UJ	Average RRF below 0.1
Rinse Blank	Acrolein	UJ	Average RRF below 0.1
Rinse Blank	Acetone	J	Average RRF below 0.1
Rinse Blank	Acetonitrile	UJ	Average RRF below 0.1
Rinse Blank	acrylonitrile	UJ	Average RRF below 0.1
Rinse Blank	propionitrile	UJ	Average RRF below 0.1
Rinse Blank	isobutyl alcohol	UJ	Average RRF below 0.1
Rinse Blank	1,4-dioxane	UJ	Average RRF below 0.1
SW6004	Acrolein	UJ	Average RRF below 0.1
SW6004	Acetone	UJ	Average RRF below 0.1
SW6004	Acetonitrile	UJ	Average RRF below 0.1
SW6004	acrylonitrile	UJ	Average RRF below 0.1
SW6004	propionitrile	UJ	Average RRF below 0.1
SW6004	isobutyl alcohol	UJ	Average RRF below 0.1
SW6004	1,4-dioxane	UJ	Average RRF below 0.1
SW6003	Acrolein	UJ	Average RRF below 0.1
SW6003	Acetone	J	Average RRF below 0.1
SW6003	Acetonitrile	UJ	Average RRF below 0.1
SW6003	acrylonitrile	UJ	Average RRF below 0.1
SW6003	propionitrile	UJ	Average RRF below 0.1
SW6003	isobutyl alcohol	UJ	Average RRF below 0.1
SW6003	1,4-dioxane	UJ	Average RRF below 0.1
Trip Blank (10-17-04)	Acrolein	UJ	Average RRF below 0.1
Trip Blank (10-17-04)	Acetone	UJ	Average RRF below 0.1
Trip Blank (10-17-04)	Acetonitrile	UJ	Average RRF below 0.1
Trip Blank (10-17-04)	acrylonitrile	UJ	Average RRF below 0.1
Trip Blank (10-17-04)	propionitrile	UJ	Average RRF below 0.1
Trip Blank (10-17-04)	isobutyl alcohol	UJ	Average RRF below 0.1
Trip Blank (10-17-04)	1,4-dioxane	UJ	Average RRF below 0.1
Trip Blank (10-18-04)	Acrolein	UJ	Average RRF below 0.1
Trip Blank (10-18-04)	Acetone	UJ	Average RRF below 0.1
Trip Blank (10-18-04)	Acetonitrile	UJ	Average RRF below 0.1
Trip Blank (10-18-04)	acrylonitrile	UJ	Average RRF below 0.1
Trip Blank (10-18-04)	propionitrile	UJ	Average RRF below 0.1
Trip Blank (10-18-04)	isobutyl alcohol	UJ	Average RRF below 0.1
Trip Blank (10-18-04)	1,4-dioxane	UJ	Average RRF below 0.1
SD6002	Acrolein	UJ	Average RRF below 0.1
SD6002	Acetone	J	Average RRF below 0.1
SD6002	Acetonitrile	UJ	Average RRF below 0.1
SD6002	acrylonitrile	UJ	Average RRF below 0.1
SD6002	propionitrile	UJ	Average RRF below 0.1

Quality Assurance Review

Preliminary Corrective Measures Study, Treated Wood Products Plant, Wiggins, Mississippi

Sample ID	Analyte	Qualification	Reason for Qualification
SD6002	isobutyl alcohol	UJ	Average RRF below 0.1
SD6002	1,4-dioxane	UJ	Average RRF below 0.1
SD6003	Acrolein	UJ	Average RRF below 0.1
SD6003	Acetone	J	Average RRF below 0.1
SD6003	Acetonitrile	UJ	Average RRF below 0.1
SD6003	acrylonitrile	UJ	Average RRF below 0.1
SD6003	propionitrile	UJ	Average RRF below 0.1
SD6003	isobutyl alcohol	UJ	Average RRF below 0.1
SD6003	1,4-dioxane	UJ	Average RRF below 0.1
SD6005	Acrolein	UJ	Average RRF below 0.1
SD6005	Acetone	J	Average RRF below 0.1
SD6005	Acetonitrile	UJ	Average RRF below 0.1
SD6005	acrylonitrile	UJ	Average RRF below 0.1
SD6005	propionitrile	UJ	Average RRF below 0.1
SD6005	isobutyl alcohol	UJ	Average RRF below 0.1
SD6005	1,4-dioxane	UJ	Average RRF below 0.1
SD6007	Acrolein	UJ	Average RRF below 0.1
SD6007	Acetone	J	Average RRF below 0.1
SD6007	Acetonitrile	UJ	Average RRF below 0.1
SD6007	acrylonitrile	UJ	Average RRF below 0.1
SD6007	propionitrile	UJ	Average RRF below 0.1
SD6007	isobutyl alcohol	UJ	Average RRF below 0.1
SD6007	1,4-dioxane	UJ	Average RRF below 0.1
SD6006	Acrolein	UJ	Average RRF below 0.1
SD6006	Acetone	J	Average RRF below 0.1
SD6006	Acetonitrile	UJ	Average RRF below 0.1
SD6006	acrylonitrile	UJ	Average RRF below 0.1
SD6006	propionitrile	UJ	Average RRF below 0.1
SD6006	isobutyl alcohol	UJ	Average RRF below 0.1
SD6006	1,4-dioxane	UJ	Average RRF below 0.1
SD6004	Acrolein	UJ	Average RRF below 0.1
SD6004	Acetone	J	Average RRF below 0.1
SD6004	Acetonitrile	UJ	Average RRF below 0.1
SD6004	acrylonitrile	UJ	Average RRF below 0.1
SD6004	propionitrile	UJ	Average RRF below 0.1
SD6004	isobutyl alcohol	UJ	Average RRF below 0.1
SD6004	1,4-dioxane	UJ	Average RRF below 0.1
SD6011	Acrolein	UJ	Average RRF below 0.1
SD6011	Acetone	J	Average RRF below 0.1
SD6011	Acetonitrile	UJ	Average RRF below 0.1
SD6011	acrylonitrile	UJ	Average RRF below 0.1
SD6011	propionitrile	UJ	Average RRF below 0.1
SD6011	isobutyl alcohol	UJ	Average RRF below 0.1
SD6011	1,4-dioxane	UJ	Average RRF below 0.1
SW6004	4,4'-DDT	UJ	Calibration verification % D > 20
SW6002	4,4'-DDT	UJ	Calibration verification % D > 20
Rinse Blank Soil	4,4'-DDT	UJ	Calibration verification % D > 20
Rinse Blank	4,4'-DDT	UJ	Calibration verification % D > 20
SW6003	4,4'-DDT	UJ	Calibration verification % D > 20
SD6002	alpha-BHC	UJ	Calibration verification % D > 20
SD6002	gamma-BHC	UJ	Calibration verification % D > 20
SD6002	beta-BHC	UJ	Calibration verification % D > 20
SD6002	delta-BHC	UJ	Calibration verification % D > 20
SD6002	Heptachlor	UJ	Calibration verification % D > 20
SD6002	Heptachlor epoxide	UJ	Calibration verification % D > 20
SD6002	gamma chlordane	UJ	Calibration verification % D > 20
SD6002	alpha chlordane	UJ	Calibration verification % D > 20
SD6002	Endrin	UJ	Calibration verification % D > 20

Quality Assurance Review

Preliminary Corrective Measures Study, Treated Wood Products Plant, Wiggins, Mississippi

Sample ID	Analyte	Qualification	Reason for Qualification
SD6002	Endosulfan II	UJ	Calibration verification % D > 20
SD6002	4,4'-DDT	UJ	Calibration verification % D > 20
SD6002	Endrin aldehyde	UJ	Calibration verification % D > 20
SD6002	Methoxychlor	UJ	Calibration verification % D > 20
SD6002	Endosulfan sulfate	UJ	Calibration verification % D > 20
SD6002	Endrin ketone	UJ	Calibration verification % D > 20
SD6003	alpha-BHC	UJ	Calibration verification % D > 20
SD6003	gamma-BHC	UJ	Calibration verification % D > 20
SD6003	beta-BHC	UJ	Calibration verification % D > 20
SD6003	delta-BHC	UJ	Calibration verification % D > 20
SD6003	Heptachlor	UJ	Calibration verification % D > 20
SD6003	Heptachlor epoxide	UJ	Calibration verification % D > 20
SD6003	gamma chlordane	UJ	Calibration verification % D > 20
SD6003	alpha chlordane	UJ	Calibration verification % D > 20
SD6003	Endrin	UJ	Calibration verification % D > 20
SD6003	Endosulfan II	UJ	Calibration verification % D > 20
SD6003	4,4'-DDT	UJ	Calibration verification % D > 20
SD6003	Endrin aldehyde	UJ	Calibration verification % D > 20
SD6003	Methoxychlor	UJ	Calibration verification % D > 20
SD6003	Endosulfan sulfate	UJ	Calibration verification % D > 20
SD6003	Endrin ketone	UJ	Calibration verification % D > 20
SD6005	alpha-BHC	UJ	Calibration verification % D > 20
SD6005	gamma-BHC	UJ	Calibration verification % D > 20
SD6005	beta-BHC	UJ	Calibration verification % D > 20
SD6005	delta-BHC	UJ	Calibration verification % D > 20
SD6005	Heptachlor	UJ	Calibration verification % D > 20
SD6005	Heptachlor epoxide	UJ	Calibration verification % D > 20
SD6005	gamma chlordane	UJ	Calibration verification % D > 20
SD6005	alpha chlordane	UJ	Calibration verification % D > 20
SD6005	Endrin	UJ	Calibration verification % D > 20
SD6005	Endosulfan II	UJ	Calibration verification % D > 20
SD6005	4,4'-DDT	UJ	Calibration verification % D > 20
SD6005	Endrin aldehyde	UJ	Calibration verification % D > 20
SD6005	Methoxychlor	UJ	Calibration verification % D > 20
SD6005	Endosulfan sulfate	UJ	Calibration verification % D > 20
SD6005	Endrin ketone	UJ	Calibration verification % D > 20
SD6011	alpha-BHC	UJ	Calibration verification % D > 20
SD6011	gamma-BHC	UJ	Calibration verification % D > 20
SD6011	beta-BHC	UJ	Calibration verification % D > 20
SD6011	delta-BHC	UJ	Calibration verification % D > 20
SD6011	Heptachlor	UJ	Calibration verification % D > 20
SD6011	Heptachlor epoxide	UJ	Calibration verification % D > 20
SD6011	gamma chlordane	UJ	Calibration verification % D > 20
SD6011	alpha chlordane	UJ	Calibration verification % D > 20
SD6011	Endrin	UJ	Calibration verification % D > 20
SD6011	Endosulfan II	UJ	Calibration verification % D > 20
SD6011	4,4'-DDT	UJ	Calibration verification % D > 20
SD6011	Endrin aldehyde	UJ	Calibration verification % D > 20
SD6011	Methoxychlor	UJ	Calibration verification % D > 20
SD6011	Endosulfan sulfate	UJ	Calibration verification % D > 20
SD6011	Endrin ketone	UJ	Calibration verification % D > 20
SD6004	alpha-BHC	UJ	Calibration verification % D > 20
SD6004	gamma-BHC	UJ	Calibration verification % D > 20
SD6004	beta-BHC	UJ	Calibration verification % D > 20
SD6004	delta-BHC	UJ	Calibration verification % D > 20
SD6004	Heptachlor	UJ	Calibration verification % D > 20
SD6004	Heptachlor epoxide	UJ	Calibration verification % D > 20
SD6004	gamma chlordane	UJ	Calibration verification % D > 20

Quality Assurance Review

Preliminary Corrective Measures Study, Treated Wood Products Plant, Wiggins, Mississippi

Sample ID	Analyte	Qualification	Reason for Qualification
SD6004	alpha chlordane	UJ	Calibration verification % D > 20
SD6004	Endrin	UJ	Calibration verification % D > 20
SD6004	Endosulfan II	UJ	Calibration verification % D > 20
SD6004	4,4'-DDT	UJ	Calibration verification % D > 20
SD6004	Endrin aldehyde	UJ	Calibration verification % D > 20
SD6004	Methoxychlor	UJ	Calibration verification % D > 20
SD6004	Endosulfan sulfate	UJ	Calibration verification % D > 20
SD6004	Endrin ketone	UJ	Calibration verification % D > 20
SD6006	alpha-BHC	UJ	Calibration verification % D > 20
SD6006	gamma-BHC	UJ	Calibration verification % D > 20
SD6006	beta-BHC	UJ	Calibration verification % D > 20
SD6006	delta-BHC	UJ	Calibration verification % D > 20
SD6006	Heptachlor	UJ	Calibration verification % D > 20
SD6006	Heptachlor epoxide	UJ	Calibration verification % D > 20
SD6006	gamma chlordane	UJ	Calibration verification % D > 20
SD6006	alpha chlordane	UJ	Calibration verification % D > 20
SD6006	Endrin	UJ	Calibration verification % D > 20
SD6006	Endosulfan II	UJ	Calibration verification % D > 20
SD6006	4,4'-DDT	UJ	Calibration verification % D > 20
SD6006	Endrin aldehyde	UJ	Calibration verification % D > 20
SD6006	Methoxychlor	UJ	Calibration verification % D > 20
SD6006	Endosulfan sulfate	UJ	Calibration verification % D > 20
SD6006	Endrin ketone	UJ	Calibration verification % D > 20
SD6007	alpha-BHC	UJ	Calibration verification % D > 20
SD6007	gamma-BHC	UJ	Calibration verification % D > 20
SD6007	beta-BHC	UJ	Calibration verification % D > 20
SD6007	delta-BHC	UJ	Calibration verification % D > 20
SD6007	Heptachlor	UJ	Calibration verification % D > 20
SD6007	Heptachlor epoxide	UJ	Calibration verification % D > 20
SD6007	gamma chlordane	UJ	Calibration verification % D > 20
SD6007	alpha chlordane	UJ	Calibration verification % D > 20
SD6007	Endrin	UJ	Calibration verification % D > 20
SD6007	Endosulfan II	UJ	Calibration verification % D > 20
SD6007	4,4'-DDT	UJ	Calibration verification % D > 20
SD6007	Endrin aldehyde	UJ	Calibration verification % D > 20
SD6007	Methoxychlor	UJ	Calibration verification % D > 20
SD6007	Endosulfan sulfate	UJ	Calibration verification % D > 20
SD6007	Endrin ketone	UJ	Calibration verification % D > 20
SD6002	Methylene chloride	U at reporting limit	Result < RL & < 5 X method blank level
SD6003	Methylene chloride	U at reporting limit	Result < RL & < 5 X method blank level
SD6005	Methylene chloride	U at reporting limit	Result < RL & < 5 X method blank level
SD6011	Methylene chloride	U at reporting limit	Result < RL & < 5 X method blank level
SD6004	Methylene chloride	U at reporting limit	Result < RL & < 5 X method blank level
SD6006	Methylene chloride	U at reporting limit	Result < RL & < 5 X method blank level
SD6007	Methylene chloride	U at reporting limit	Result < RL & < 5 X method blank level
SW6004	Toluene	U at reporting limit	Result < RL & < 5 X method blank level
SD6003	Toluene	J	Field duplicate RPD greater than 50
SD6011	Toluene	J	Field duplicate RPD greater than 50
SW6002	Aniline	UJ	Calibration verification %D > 20
Rinse Blank	Aniline	UJ	Calibration verification %D > 20
SW6004	Aniline	UJ	Calibration verification %D > 20

Quality Assurance Review

Preliminary Corrective Measures Study, Treated Wood Products Plant, Wiggins, Mississippi

Sample ID	Analyte	Qualification	Reason for Qualification
SW6003	Aniline	UJ	Calibration verification %D > 20
SW6002	3,3'-dimethylbenzidine	UJ	Calibration verification %D > 20
Rinse Blank	3,3'-dimethylbenzidine	UJ	Calibration verification %D > 20
SW6004	3,3'-dimethylbenzidine	UJ	Calibration verification %D > 20
SW6003	3,3'-dimethylbenzidine	UJ	Calibration verification %D > 20
Rinse Blank	Diethyl phthalate	J	LCS recovery above laboratory limit
SD5010	acenaphthylene	J	Field duplicate RPD greater than 50
SD5010	pentachlorophenol	J	Field duplicate RPD greater than 50
SD5010	phenanthrene	J	Field duplicate RPD greater than 50
SD5010	Anthracene	J	Field duplicate RPD greater than 50
SD5010	Fluoranthene	J	Field duplicate RPD greater than 50
SD5010	Pyrene	J	Field duplicate RPD greater than 50
SD5010	Chrysene	J	Field duplicate RPD greater than 50
SD5010	benzo(a)anthracene	J	Field duplicate RPD greater than 50
SD5010	benzo(a)pyrene	J	Field duplicate RPD greater than 50
SD5010	benzo(b)fluoranthene	J	Field duplicate RPD greater than 50
SD5010	benzo(k)fluoranthene	J	Field duplicate RPD greater than 50
SD5010	indeno(1,2,3,-cd)pyrene	J	Field duplicate RPD greater than 50
SD5010	benzo(g,h,i)perylene	J	Field duplicate RPD greater than 50
SD5011	acenaphthylene	J	Field duplicate RPD greater than 50
SD5011	pentachlorophenol	J	Field duplicate RPD greater than 50
SD5011	phenanthrene	J	Field duplicate RPD greater than 50
SD5011	Anthracene	J	Field duplicate RPD greater than 50
SD5011	Fluoranthene	J	Field duplicate RPD greater than 50
SD5011	Pyrene	J	Field duplicate RPD greater than 50
SD5011	Chrysene	J	Field duplicate RPD greater than 50
SD5011	benzo(a)anthracene	J	Field duplicate RPD greater than 50
SD5011	benzo(a)pyrene	J	Field duplicate RPD greater than 50
SD5011	benzo(b)fluoranthene	J	Field duplicate RPD greater than 50
SD5011	benzo(k)fluoranthene	J	Field duplicate RPD greater than 50
SD5011	indeno(1,2,3,-cd)pyrene	J	Field duplicate RPD greater than 50
SD5011	benzo(g,h,i)perylene	J	Field duplicate RPD greater than 50
SW6002	Mercury	UJ	CCV recovery < Work Plan criteria
Rinse Blank	Mercury	UJ	CCV recovery < Work Plan criteria
Rinse Blank	Arsenic	UJ	CRI recovery < 70%
SW6004	Mercury	UJ	CCV recovery < Work Plan criteria
SW6003	Mercury	UJ	CCV recovery < Work Plan criteria
SD6002	Thallium	U	Result < 5 times the ICB level
SD6003	Thallium	U	Result < 5 times the ICB level
SD6005	Thallium	U	Result < 5 times the ICB level
SD6011	Thallium	U	Result < 5 times the ICB level
SD6004	Thallium	U	Result < 5 times the ICB level
SD6006	Thallium	U	Result < 5 times the ICB level
SD6007	Thallium	U	Result < 5 times the ICB level
SD6005	Antimony	U	Result < 5 times the ICB level
SD6011	Antimony	U	Result < 5 times the ICB level
SD6004	Antimony	U	Result < 5 times the ICB level
SD6006	Antimony	U	Result < 5 times the ICB level
SD6007	Antimony	U	Result < 5 times the ICB level
SD6002	Tin	U	Result < 5 times the ICB level
SD6003	Tin	U	Result < 5 times the ICB level
SD6005	Tin	U	Result < 5 times the ICB level
SD6011	Tin	U	Result < 5 times the ICB level
SD6004	Tin	U	Result < 5 times the ICB level
SD6006	Tin	U	Result < 5 times the ICB level
SD6007	Tin	U	Result < 5 times the ICB level
Rinse Blank	Lead	U	Result < 5 times the method blank level
SW6004	Chromium	U	Result < 5 times the method blank level

Quality Assurance Review

Preliminary Corrective Measures Study, Treated Wood Products Plant, Wiggins, Mississippi

Sample ID	Analyte	Qualification	Reason for Qualification
SW6004	Copper	U	Result < 5 times the field blank level
SW6004	Nickel	U	Result < 5 times the field blank level
SW6004	Zinc	U	Result < 5 times the field blank level
SD5001	pH	J	Analysis holding time exceeded
SD5002	pH	J	Analysis holding time exceeded
SD5003	pH	J	Analysis holding time exceeded
SD5004	pH	J	Analysis holding time exceeded
SD5005	pH	J	Analysis holding time exceeded
SD5006	pH	J	Analysis holding time exceeded
SD5007	pH	J	Analysis holding time exceeded
SD5008	pH	J	Analysis holding time exceeded
SD5009	pH	J	Analysis holding time exceeded
SD5010	pH	J	Analysis holding time exceeded
SD6002	pH	J	Analysis holding time exceeded
SD6003	pH	J	Analysis holding time exceeded
SD6005	pH	J	Analysis holding time exceeded
SD6011	pH	J	Analysis holding time exceeded
SD6004	pH	J	Analysis holding time exceeded
SD6006	pH	J	Analysis holding time exceeded
SD6007	pH	J	Analysis holding time exceeded
SW6002	Hexavalent chromium	UJ	Analysis holding time exceeded
SW6003	Hexavalent chromium	UJ	Analysis holding time exceeded
SW6004	Hexavalent chromium	UJ	Analysis holding time exceeded
Rinse Blank	Hexavalent chromium	UJ	Analysis holding time exceeded
SD6010	Methylene chloride	U at reporting limit	Result < RL & < 5 times method blank level
SD6009	Methylene chloride	U at reporting limit	Result < RL & < 5 times method blank level
SD6008	Methylene chloride	U at reporting limit	Result < RL & < 5 times method blank level
SW6001	Toluene	U at reporting limit	Result < RL & < 5 times the trip blank level
SW6005	Acetone	U at reporting limit	Result < RL & < 5 times the trip blank level
SW6007	Acetone	U at reporting limit	Result < RL & < 5 times the trip blank level
SD6009	Vinyl acetate	R	MS and MSD recovery below 10%
SD6009	Isobutyl alcohol	UJ	MS & MSD recovery below lab limits
SD6009	Ethyl methacrylate	UJ	MS & MSD recovery below lab limits
SW6006	Benzyl alcohol	J	LCS recovery above laboratory limits
SW6006	4-methylphenol	J	LCS recovery above laboratory limits
SD6001	All TICs	NJ**	Tentatively identified, estimated concentration
SD6001	TIC at 22.29	Unknown hydrocarbon**	Correction
SD6001	TIC at 24.29	Unknown**	Correction
SD6001	TIC at 25.93	Unknown**	Correction
SW6006	Aroclor 1016	UJ	Surrogate recovery below lab limits
SW6006	Aroclor 1221	UJ	Surrogate recovery below lab limits
SW6006	Aroclor 1232	UJ	Surrogate recovery below lab limits
SW6006	Aroclor 1242	UJ	Surrogate recovery below lab limits
SW6006	Aroclor 1248	UJ	Surrogate recovery below lab limits
SW6006	Aroclor 1254	UJ	Surrogate recovery below lab limits
SW6006	Aroclor 1260	UJ	Surrogate recovery below lab limits
SW6006	All organophosphorus pesticides	R	Surrogate recovery below 10%
SW6006	Aldrin	UJ	MS & MSD recovery below lab limits
SD6010	Disulfoton	UJ	MS & MSD recovery below lab limits
SW6005	Chromium	U	Result < 5 times the method blank level

Quality Assurance Review

Preliminary Corrective Measures Study, Treated Wood Products Plant, Wiggins, Mississippi

Sample ID	Analyte	Qualification	Reason for Qualification
SW6007	Chromium	U	Result < 5 times the method blank level
SD6001	Silver	U	Result < 5 times the method blank level
SD6001	Tin	U	Result < 5 times the method blank level
SD6009	Tin	U	Result < 5 times the method blank level
SD6009	Antimony	J	MS & MSD recovery below lab limits
SW6005	Tin	J	Field duplicate RPD > 35
SW6005	Zinc	J	Field duplicate RPD > 35
SW6007	Tin	J	Field duplicate RPD > 35
SW6007	Zinc	J	Field duplicate RPD > 35
SD5011	pH	J	Analysis holding time exceeded
SD5012	pH	J	Analysis holding time exceeded
SD6001	pH	J	Analysis holding time exceeded
SW6006	Hexavalent chromium	UJ	Analysis holding time exceeded
SW6005	Hexavalent chromium	UJ	Analysis holding time exceeded
SW6007	Hexavalent chromium	UJ	Analysis holding time exceeded
SD6010	Total organic carbon	J	Analysis holding time exceeded
SD6009	Total organic carbon	J	Analysis holding time exceeded
SD6008	Total organic carbon	J	Analysis holding time exceeded
SW6006	Cyanide	J	MS recovery below Work Plan criteria
SW6005	Cyanide	U*	Correct laboratory EDD flag
SW6007	Cyanide	U*	Correct laboratory EDD flag

* Flag applied to database files only

** Correction/flag applied to hardcopy data only

Appendix B

Validated CMS Analytical Results

Table B1 – Soil Sample Analyses

Table B2 – Sediment Sample Analyses

Table B1 – Surface Water Sample Analyses

Table B1 - Validated results of soil sample analyses

Station			D1-1	D1-2	D1-3	D1-4	D3-1	D3-2	D3-3
Sample			SD5001	SD5002	SD5003	SD5004	SD5005	SD5006	SD5007
Date			10/13/04	10/13/04	10/13/04	10/13/04	10/13/04	10/13/04	10/13/04
Depth			0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In
Analyte	Method	Units							
Carbon, Total Organic (TOC)	SID, S3	mg/Kg	6500	2200	2800	1900	14000	1300	8100
Solids, Total	160.3M	%	84.7	87.8	92	86.1	76.9	84.4	85.8
pH	9045C	PH	6.1 J	6.5 J	6.3 J	6.7 J	6 J	6.7 J	5.6 J
Arsenic, Total	6020	mg/Kg	28.6	17.6	12.6	14.4	8.45	2.16	8.16
Chromium, Total	6020	mg/Kg	37.8	27.9	23.6	19.1	14.7	4.05	15.3
2-Methylnaphthalene	8270C SIM	ug/Kg	0.73 U	0.71 U	0.69 U	0.75 U	0.82 U	0.75 U	0.8 U
Acenaphthene	8270C SIM	ug/Kg	1.2 U	1.7 J	1.1 U	1.2 U	1.3 U	1.2 U	1.3 U
Acenaphthylene	8270C SIM	ug/Kg	0.76 U	0.74 U	0.72 U	0.79 U	0.86 U	0.78 U	0.84 U
Anthracene	8270C SIM	ug/Kg	0.8 J	8.3	0.73 U	0.94 J	3.2 J	1.7 J	1.5 J
Benz(a)anthracene	8270C SIM	ug/Kg	5.8	37	4.4	7.6	19	11	11
Benzo(a)pyrene	8270C SIM	ug/Kg	1.8 U	24	1.7 U	2.8 J	11	7.9	5.7
Benzo(b)fluoranthene	8270C SIM	ug/Kg	4.8	41	3.3 J	7.4	21	15	12
Benzo(g,h,i)perylene	8270C SIM	ug/Kg	4.6	18	3.6 J	5.8	12	8.9	8.2
Benzo(k)fluoranthene	8270C SIM	ug/Kg	2.1 U	8.2	2 U	2.2 U	2.4 U	2.2 U	2.3 U
Chrysene	8270C SIM	ug/Kg	5.1	31	3.8	6.6	16	10	9.3
Dibenz(a,h)anthracene	8270C SIM	ug/Kg	2.3 U	2.3 U	2.2 U	2.4 U	2.6 U	2.4 U	2.6 U
Fluoranthene	8270C SIM	ug/Kg	9	69	7	13	35	22	18
Fluorene	8270C SIM	ug/Kg	0.69 U	1.8 J	0.66 U	0.72 U	0.78 U	0.71 U	0.76 U
Indeno(1,2,3-cd)pyrene	8270C SIM	ug/Kg	5.8	22	4.7	7.3	14	11	10
Naphthalene	8270C SIM	ug/Kg	0.58 U	0.57 U	0.55 U	0.6 U	0.65 U	0.59 U	0.63 U
Pentachlorophenol (PCP)	8270C SIM	ug/Kg	0.46 U	0.45 U	0.44 U	0.48 U	0.52 U	0.48 U	0.51 U
Phenanthrene	8270C SIM	ug/Kg	3.5 J	28	2.4 J	4 J	13	6	5.5
Pyrene	8270C SIM	ug/Kg	8.1	54	6	11	28	17	15
Benzene	8260B	ug/Kg	0.094 U	0.093 U	0.086 U	0.093 U	0.11 U	0.094 U	0.093 U

Notes:

U - not detected at detection limit shown

J - estimated

In - Inch

Table B1 - Validated results of soil sample analyses (continued)

Station			D3-4	D1-C	D2-C	D2-C	D1/D2-C
Sample			SD5008	SD5009	SD5010	SD5011	SD5012
Date			10/13/04	10/13/04	10/13/04	10/13/04	10/13/04
Depth			0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In
			Field dup				
Carbon, Total Organic (TOC)	SID, S3	mg/Kg	2400	8700	7800	6200	10000
Solids, Total	160.3M	%	87.5	85.2	88.2	88.8	88.7
pH	9045C	PH	6.8 J	6.4 J	5.9 J	6.8 J	6.6 J
Arsenic, Total	6020	mg/Kg	4.32	23.9	18.7	18	28.8
Chromium, Total	6020	mg/Kg	8.17	65.8	47.4	36.5	49.2
2-Methylnaphthalene	8270C SIM	ug/Kg	0.76 U	0.72 U	0.72 U	0.72 U	1.5 J
Acenaphthene	8270C SIM	ug/Kg	1.2 U	1.2 U	19	1.2 U	1.4 J
Acenaphthylene	8270C SIM	ug/Kg	0.79 U	0.76 U	90 J	3.7 J	26
Anthracene	8270C SIM	ug/Kg	0.8 U	1.5 J	280 J	7.9 J	88
Benz(a)anthracene	8270C SIM	ug/Kg	6.1	8.6	3300 J	22 J	200
Benzo(a)pyrene	8270C SIM	ug/Kg	1.8 U	4	1000 J	13 J	120
Benzo(b)fluoranthene	8270C SIM	ug/Kg	5.5	10	4600 J	54 J	440
Benzo(g,h,i)perylene	8270C SIM	ug/Kg	4.4	6.9	430 J	11 J	68
Benzo(k)fluoranthene	8270C SIM	ug/Kg	2.2 U	2.1 U	680 J	17 J	150
Chrysene	8270C SIM	ug/Kg	5.4	8.1	4300 J	34 J	440
Dibenz(a,h)anthracene	8270C SIM	ug/Kg	2.4 U	2.3 U	200	2.3 U	21
Fluoranthene	8270C SIM	ug/Kg	10	16	20000 J	41 J	290
Fluorene	8270C SIM	ug/Kg	0.72 U	0.69 U	62	0.69 U	3.6 J
Indeno(1,2,3-cd)pyrene	8270C SIM	ug/Kg	5.8	8.3	670 J	16 J	95
Naphthalene	8270C SIM	ug/Kg	0.6 U	0.57 U	0.58 U	0.57 U	1.6 J
Pentachlorophenol (PCP)	8270C SIM	ug/Kg	0.48 U	0.46 U	5400 J	110 J	230
Phenanthrene	8270C SIM	ug/Kg	3.6 J	6.1	4400 J	7.5 J	27
Pyrene	8270C SIM	ug/Kg	8.4	14	14000 J	46 J	320
Benzene	8260B	ug/Kg	0.091 U	0.093 U	0.089 U	0.089 U	0.09 U

Notes:

U - not detected at detection limit shown

J - estimated

In - Inch

Table B2 - Validated results of sediment sample analyses

Station			SD-01/SW-01	SD-02	SD-03/SW-02	SD-03/SW-02	SD-04	SD-05/SW-03
Sample			SD6001	SD6002	SD6003	SD6011	SD6004	SD6005
Date			10/14/04	10/18/04	10/18/04	10/18/04	10/18/04	10/18/04
Depth			0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In
Analyte	Method	Units	Field dup					
Carbon, Total Organic (TOC)	SID, S3	mg/Kg	5600	9200	14000	11000	21000	12000
pH	9045C	PH	5.7 J	6.6 J	6.2 J	6.3 J	5.5 J	5.9 J
Solids, Total	160.3M	%	78	67.8	62.8	69.5	40.2	70.3
Cyanide, Total	9012A	mg/Kg	0.12	0.21 J	0.17	0.16	0.21	0.17
Antimony, Total	6020	mg/Kg	0.109 B	0.09 U	0.08 U	0.109 U	0.117 U	0.084 U
Arsenic, Total	6020	mg/Kg	0.664	0.269 U	1.1	1.34	2.94	0.84
Barium, Total	6020	mg/Kg	43.4	35.5	22	21.9	44.3	19.9
Beryllium, Total	6020	mg/Kg	0.421 B	0.345 B	0.245 U	0.27 U	0.341 B	0.257 U
Cadmium, Total	6020	mg/Kg	0.06 U	0.254 U	0.219 U	0.242 U	0.305 U	0.23 U
Chromium, Total	6020	mg/Kg	12.2	6.26	6.67	6.71	15	4.47
Cobalt, Total	6020	mg/Kg	2.59	1.39	0.839	0.843	2.1	0.58 B
Copper, Total	6020	mg/Kg	2.76	1.68	3.49	3.95	8.41	2.23
Lead, Total	6020	mg/Kg	10.1	6.53	6.83	7.95	13.1	9.28
Mercury, Total	7471	mg/Kg	--**	0.05 B	0.027 B	0.031 B	0.063 B	0.039 B
Nickel, Total	6020	mg/Kg	3.95	2.3	1.98	1.96	6.53	1.4
Selenium, Total	6020	mg/Kg	0.599 U	0.659 U	0.568 U	0.625 U	0.789 U	0.596 U
Silver, Total	6020	mg/Kg	0.085 U	0.045 B	0.03 B	0.033 B	0.063 B	0.035 B
Thallium, Total	6020	mg/Kg	0.301 B	0.2 U	0.076 U	0.072 U	0.153 U	0.082 U
Tin, Total	6020	mg/Kg	1.82 U	1.44 U	1.44 U	1.49 U	1.79 U	1.01 U
Vanadium, Total	6020	mg/Kg	25	8.55	10.4	11.3	30	7.9
Zinc, Total	6020	mg/Kg	10.7	6.5 B	11.8	13.7	24.4	7.64
2,4,5-T	8151A	ug/Kg	9.9 U	4 U	4 U	4 U	4 U	4 U
2,4,5-TP (Silvex)	8151A	ug/Kg	8.6 U	3.5 U	3.5 U	3.5 U	3.5 U	3.5 U
2,4-D	8151A	ug/Kg	110 U	44 U	44 U	44 U	44 U	44 U
4,4'-DDD	8081A	ug/Kg	0.59 U	0.61 U	1 U	0.66 U	1.4 U	0.67 U
4,4'-DDE	8081A	ug/Kg	0.18 U	0.19 U	0.31 U	0.2 U	0.41 U	0.21 U
4,4'-DDT	8081A	ug/Kg	0.2 U	0.2 UJ	0.33 UJ	0.22 UJ	0.44 UJ	0.22 UJ
Aldrin	8081A	ug/Kg	0.27 U	0.28 U	0.46 U	0.3 U	0.61 U	0.31 U
alpha-BHC	8081A	ug/Kg	0.23 U	0.24 UJ	0.39 UJ	0.26 UJ	0.53 UJ	0.27 UJ
alpha-Chlordane	8081A	ug/Kg	0.18 U	0.19 UJ	0.31 UJ	0.2 UJ	0.41 UJ	0.21 UJ
Aroclor 1016	8082A	ug/Kg	13 U	15 U	20 U	15 U	26 U	14 U
Aroclor 1221	8082A	ug/Kg	27 U	31 U	43 U	31 U	55 U	29 U
Aroclor 1232	8082A	ug/Kg	20 U	23 U	32 U	23 U	41 U	22 U
Aroclor 1242	8082A	ug/Kg	7.3 U	8.4 U	12 U	8.3 U	15 U	7.9 U
Aroclor 1248	8082A	ug/Kg	9 U	11 U	15 U	11 U	19 U	9.8 U

Table B2 - Validated results of sediment sample analyses (continued)

Station			SD-01/SW-01	SD-02	SD-03/SW-02	SD-03/SW-02	SD-04	SD-05/SW-03
Sample			SD6001	SD6002	SD6003	SD6011	SD6004	SD6005
Date			10/14/04	10/18/04	10/18/04	10/18/04	10/18/04	10/18/04
Depth			0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In
Analyte	Method	Units	Field dup					
Aroclor 1254	8082A	ug/Kg	6.6 U	7.7 U	11 U	7.6 U	14 U	7.2 U
Aroclor 1260	8082A	ug/Kg	3.6 U	4.2 U	5.7 U	4.1 U	7.4 U	3.9 U
beta-BHC	8081A	ug/Kg	0.35 U	0.36 UJ	0.59 UJ	0.39 UJ	0.79 UJ	0.4 UJ
delta-BHC	8081A	ug/Kg	0.18 U	0.19 UJ	0.31 UJ	0.2 UJ	0.41 UJ	0.21 UJ
Dieldrin	8081A	ug/Kg	0.35 U	0.36 U	0.59 U	0.39 U	0.79 U	0.4 U
Endosulfan I	8081A	ug/Kg	0.22 U	0.23 U	0.37 U	0.25 U	0.5 U	0.25 U
Endosulfan II	8081A	ug/Kg	0.27 U	0.28 UJ	0.46 UJ	0.3 UJ	0.61 UJ	0.31 UJ
Endosulfan Sulfate	8081A	ug/Kg	0.25 U	0.26 UJ	0.41 UJ	0.28 UJ	0.56 UJ	0.28 UJ
Endrin	8081A	ug/Kg	0.26 U	0.27 UJ	0.44 UJ	0.29 UJ	0.59 UJ	0.3 UJ
Endrin Aldehyde	8081A	ug/Kg	0.26 U	0.27 UJ	0.44 UJ	0.29 UJ	0.59 UJ	0.3 UJ
Endrin Ketone	8081A	ug/Kg	0.4 U	0.41 UJ	0.67 UJ	0.45 UJ	0.91 UJ	0.46 UJ
gamma-BHC (Lindane)	8081A	ug/Kg	0.75 U	0.78 UJ	1.3 UJ	0.85 UJ	1.8 UJ	0.86 UJ
gamma-Chlordane	8081A	ug/Kg	0.93 U	0.97 UJ	1.6 UJ	1.1 UJ	2.2 UJ	1.1 UJ
Heptachlor	8081A	ug/Kg	0.6 U	0.63 UJ	1.1 UJ	0.68 UJ	1.4 UJ	0.69 UJ
Heptachlor Epoxide	8081A	ug/Kg	0.21 U	0.22 UJ	0.35 UJ	0.23 UJ	0.47 UJ	0.24 UJ
Methoxychlor	8081A	ug/Kg	0.21 U	0.22 UJ	0.35 UJ	0.23 UJ	0.47 UJ	0.24 UJ
Toxaphene	8081A	ug/Kg	44 U	45 U	74 U	49 U	99 U	50 U
Azinphos-methyl (Guthion)	8141A	ug/kg	8.1 U	9.3 U	11 U	9.1 U	16 U	9 U
Bolstar (Sulprofos)	8141A	ug/kg	12 U	14 U	15 U	13 U	23 U	13 U
Chlorpyrifos	8141A	ug/kg	35 U	40 U	43 U	39 U	68 U	39 U
Coumaphos	8141A	ug/kg	9.9 U	12 U	13 U	12 U	20 U	11 U
Demeton-O,S	8141A	ug/kg	16 U	19 U	20 U	19 U	31 U	19 U
Diazinon	8141A	ug/kg	9.3 U	11 U	12 U	11 U	18 U	11 U
Dichlorvos	8141A	ug/kg	13 U	15 U	16 U	15 U	25 U	15 U
Dimethoate	8141A	ug/kg	38 U	43 U	47 U	42 U	73 U	42 U
Disulfoton	8141A	ug/kg	30 U	34 U	37 U	34 U	58 U	33 U
EPN	8141A	ug/kg	11 U	13 U	14 U	13 U	21 U	12 U
Ethoprop (Prophos)	8141A	ug/kg	9 U	11 U	12 U	11 U	18 U	10 U
Fensulfothion	8141A	ug/kg	15 U	17 U	18 U	16 U	28 U	16 U
Fenthion	8141A	ug/kg	11 U	13 U	14 U	13 U	21 U	12 U
Malathion	8141A	ug/kg	9.8 U	12 U	13 U	11 U	19 U	11 U
Merphos	8141A	ug/kg	5.2 U	5.9 U	6.4 U	5.8 U	10 U	5.7 U
Methyl Parathion	8141A	ug/kg	11 U	13 U	14 U	13 U	21 U	12 U
Mevinphos	8141A	ug/kg	11 U	13 U	14 U	13 U	22 U	13 U
Parathion	8141A	ug/kg	11 U	13 U	14 U	12 U	21 U	12 U

Table B2 - Validated results of sediment sample analyses (continued)

Station			SD-01/SW-01	SD-02	SD-03/SW-02	SD-03/SW-02	SD-04	SD-05/SW-03
Sample			SD6001	SD6002	SD6003	SD6011	SD6004	SD6005
Date			10/14/04	10/18/04	10/18/04	10/18/04	10/18/04	10/18/04
Depth			0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In
Analyte	Method	Units	Field dup					
Phorate	8141A	ug/kg	29 U	33 U	36 U	32 U	55 U	32 U
Ronnel	8141A	ug/kg	11 U	13 U	14 U	12 U	21 U	12 U
Stirophos (Tetrachlorovinphos)	8141A	ug/kg	8.9 U	11 U	11 U	10 U	18 U	9.9 U
Sulfotep	8141A	ug/kg	9.7 U	12 U	12 U	11 U	19 U	11 U
Tokuthion (Prothiofos)	8141A	ug/kg	9.9 U	12 U	13 U	12 U	20 U	11 U
Trichloronate	8141A	ug/kg	36 U	42 U	45 U	41 U	70 U	40 U
1,2,4-Trichlorobenzene	8270C	ug/Kg	18 U	22 U	20 U	22 U	26 U	21 U
1,2-Dichlorobenzene	8270C	ug/Kg	25 U	30 U	27 U	29 U	35 U	28 U
1,3-Dichlorobenzene	8270C	ug/Kg	22 U	26 U	24 U	26 U	32 U	25 U
1,4-Dichlorobenzene	8270C	ug/Kg	25 U	30 U	27 U	29 U	35 U	28 U
1-Methylnaphthalene	8270C	ug/Kg	18 U	22 U	20 U	22 U	26 U	21 U
2,4,5-Trichlorophenol	8270C	ug/Kg	17 U	20 U	19 U	20 U	24 U	19 U
2,4,6-Trichlorophenol	8270C	ug/Kg	46 U	55 U	51 U	55 U	66 U	52 U
2,4-Dichlorophenol	8270C	ug/Kg	22 U	26 U	24 U	26 U	32 U	25 U
2,4-Dimethylphenol	8270C	ug/Kg	25 U	30 U	27 U	29 U	35 U	28 U
2,4-Dinitrophenol	8270C	ug/Kg	16 U	19 U	17 U	19 U	22 U	18 U
2,4-Dinitrotoluene	8270C	ug/Kg	13 U	15 U	14 U	15 U	18 U	15 U
2,6-Dinitrotoluene	8270C	ug/Kg	46 U	55 U	51 U	55 U	66 U	52 U
2-Chloronaphthalene	8270C	ug/Kg	21 U	25 U	23 U	25 U	30 U	23 U
2-Chlorophenol	8270C	ug/Kg	23 U	28 U	26 U	28 U	33 U	26 U
2-Methylnaphthalene	8270C	ug/Kg	20 U	23 U	22 U	23 U	30 J	22 U
2-Methylphenol	8270C	ug/Kg	16 U	19 U	17 U	19 U	22 U	18 U
2-Nitroaniline	8270C	ug/Kg	28 U	34 U	31 U	34 U	41 U	32 U
2-Nitrophenol	8270C	ug/Kg	18 U	22 U	20 U	22 U	26 U	21 U
3,3'-Dichlorobenzidine	8270C	ug/Kg	44 U	52 U	48 U	52 U	63 U	49 U
3-Nitroaniline	8270C	ug/Kg	22 U	26 U	24 U	26 U	32 U	25 U
4,6-Dinitro-2-methylphenol	8270C	ug/Kg	12 U	15 U	14 U	15 U	18 U	14 U
4-Bromophenyl Phenyl Ether	8270C	ug/Kg	13 U	15 U	14 U	15 U	18 U	15 U
4-Chloro-3-methylphenol	8270C	ug/Kg	21 U	25 U	23 U	25 U	30 U	23 U
4-Chloroaniline	8270C	ug/Kg	34 U	40 U	37 U	40 U	48 U	38 U
4-Chlorophenyl Phenyl Ether	8270C	ug/Kg	28 U	34 U	31 U	34 U	41 U	32 U
4-Methylphenol	8270C	ug/Kg	34 U	40 U	37 U	40 U	180 J	53 J
4-Nitroaniline	8270C	ug/Kg	16 U	19 U	17 U	19 U	22 U	18 U
4-Nitrophenol	8270C	ug/Kg	22 U	26 U	24 U	26 U	32 U	25 U
Acenaphthene	8270C	ug/Kg	25 U	30 U	27 U	29 U	400	28 U

Table B2 - Validated results of sediment sample analyses (continued)

Station			SD-01/SW-01	SD-02	SD-03/SW-02	SD-03/SW-02	SD-04	SD-05/SW-03
Sample			SD6001	SD6002	SD6003	SD6011	SD6004	SD6005
Date			10/14/04	10/18/04	10/18/04	10/18/04	10/18/04	10/18/04
Depth			0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In
Analyte	Method	Units				Field dup		
Acenaphthylene	8270C	ug/Kg	25 U	30 U	27 U	29 U	54 J	28 U
Acetophenone	8270C	ug/Kg	110 U	130 U	120 U	130 U	160 U	120 U
Anthracene	8270C	ug/Kg	1.5 J*	17 U	16 U	17 U	420	16 U
Benz(a)anthracene	8270C	ug/Kg	14 U	17 U	16 U	17 U	830	16 U
Benzo(a)pyrene	8270C	ug/Kg	25 U	30 U	27 U	290 U	350 U	28 U
Benzo(b)fluoranthene	8270C	ug/Kg	26 U	31 U	29 U	310 U	400 J	29 U
Benzo(g,h,i)perylene	8270C	ug/Kg	21 U	25 U	23 U	250 U	300 U	23 U
Benzo(k)fluoranthene	8270C	ug/Kg	21 U	25 U	23 U	250 U	430 J	23 U
Benzyl Alcohol	8270C	ug/Kg	28 U	34 U	31 U	34 U	62 J	32 U
Bis(2-chloroethoxy)methane	8270C	ug/Kg	22 U	26 U	24 U	26 U	32 U	25 U
Bis(2-chloroethyl) Ether	8270C	ug/Kg	20 U	23 U	22 U	23 U	28 U	22 U
Bis(2-chloroisopropyl) Ether	8270C	ug/Kg	27 U	33 U	30 U	32 U	39 U	31 U
Bis(2-ethylhexyl) Phthalate	8270C	ug/Kg	21 U	25 U	56 J	66 J	70 J	23 U
Butyl Benzyl Phthalate	8270C	ug/Kg	23 U	28 U	26 U	28 U	33 U	26 U
Carbazole	8270C	ug/Kg	21 U	25 U	23 U	25 U	30 U	23 U
Chrysene	8270C	ug/Kg	28 U	34 U	31 U	34 U	960	32 U
Dibenz(a,h)anthracene	8270C	ug/Kg	28 U	34 U	31 U	340 U	410 U	32 U
Dibenzofuran	8270C	ug/Kg	17 U	20 U	19 U	20 U	270	19 U
Diethyl Phthalate	8270C	ug/Kg	16 U	19 U	17 U	19 U	22 U	18 U
Dimethyl Phthalate	8270C	ug/Kg	13 U	15 U	14 U	15 U	18 U	15 U
Di-n-butyl Phthalate	8270C	ug/Kg	78 U	94 U	86 U	92 U	120 U	88 U
Di-n-octyl Phthalate	8270C	ug/Kg	20 U	23 U	22 U	23 U	28 U	22 U
Fluoranthene	8270C	ug/Kg	3.9 J*	19 U	80 J	73 J	4900	18 J
Fluorene	8270C	ug/Kg	13 U	16 U	15 U	16 U	470	15 U
Hexachlorobenzene	8270C	ug/Kg	11 U	13 U	12 U	13 U	16 U	12 U
Hexachlorobutadiene	8270C	ug/Kg	22 U	26 U	24 U	26 U	32 U	25 U
Hexachlorocyclopentadiene	8270C	ug/Kg	14 U	17 U	16 U	17 U	21 U	16 U
Hexachloroethane	8270C	ug/Kg	22 U	26 U	24 U	26 U	32 U	25 U
Indeno(1,2,3-cd)pyrene	8270C	ug/Kg	23 U	28 U	26 U	280 U	330 U	26 U
Isophorone	8270C	ug/Kg	17 U	20 U	19 U	20 U	24 U	19 U
Naphthalene	8270C	ug/Kg	17 U	20 U	19 U	20 U	29 J	19 U
Nitrobenzene	8270C	ug/Kg	26 U	31 U	29 U	31 U	37 U	29 U
N-Nitrosodi-n-propylamine	8270C	ug/Kg	23 U	28 U	26 U	28 U	33 U	26 U
N-Nitrosodiphenylamine	8270C	ug/Kg	14 U	17 U	16 U	17 U	21 U	16 U
Pentachlorophenol (PCP)	8270C	ug/Kg	25 J*	36 U	84 J	35 U	1500	260 J

Table B2 - Validated results of sediment sample analyses (continued)

Station			SD-01/SW-01	SD-02	SD-03/SW-02	SD-03/SW-02	SD-04	SD-05/SW-03
Sample			SD6001	SD6002	SD6003	SD6011	SD6004	SD6005
Date			10/14/04	10/18/04	10/18/04	10/18/04	10/18/04	10/18/04
Depth			0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In
Analyte	Method	Units	Field dup					
Phenanthrene	8270C	ug/Kg	4 J*	20 U	32 J	30 J	1300	19 U
Phenol	8270C	ug/Kg	21 U	25 U	23 U	25 U	30 U	23 U
Pyrene	8270C	ug/Kg	6.2 J*	22 U	42 J	45 J	2500	21 U
1,2-Dichlorobenzene	8260B	ug/Kg	0.11 U	0.13 U	0.11 U	0.12 U	0.15 U	0.12 U
1,3-Dichlorobenzene	8260B	ug/Kg	0.066 U	0.077 U	0.071 U	0.076 U	0.092 U	0.072 U
1,4-Dichlorobenzene	8260B	ug/Kg	0.12 U	0.14 U	0.13 U	0.14 U	0.16 U	0.13 U
1,1,1,2-Tetrachloroethane	8260B	ug/Kg	0.078 U	0.091 U	0.083 U	0.089 U	0.11 U	0.085 U
1,1,1-Trichloroethane (TCA)	8260B	ug/Kg	0.16 U	0.19 U	0.17 U	0.19 U	0.22 U	0.18 U
1,1,2,2-Tetrachloroethane	8260B	ug/Kg	0.087 U	0.11 U	0.093 U	0.1 U	0.13 U	0.095 U
1,1,2-Trichloroethane	8260B	ug/Kg	0.18 U	0.21 U	0.19 U	0.2 U	0.24 U	0.19 U
1,1-Dichloroethane (1,1-DCA)	8260B	ug/Kg	0.083 U	0.097 U	0.089 U	0.095 U	0.12 U	0.091 U
1,1-Dichloroethene (1,1-DCE)	8260B	ug/Kg	0.23 U	0.27 U	0.24 U	0.26 U	0.32 U	0.25 U
1,2,3-Trichloropropane	8260B	ug/Kg	0.23 U	0.27 U	0.24 U	0.26 U	0.32 U	0.25 U
1,2-Dibromo-3-chloropropane (DBCP)	8260B	ug/Kg	0.65 U	0.76 U	0.69 U	0.74 U	0.9 U	0.71 U
1,2-Dibromoethane (EDB)	8260B	ug/Kg	0.074 U	0.087 U	0.079 U	0.085 U	0.11 U	0.081 U
1,2-Dichloroethane (EDC)	8260B	ug/Kg	0.14 U	0.16 U	0.15 U	0.16 U	0.19 U	0.15 U
1,2-Dichloropropane	8260B	ug/Kg	0.072 U	0.084 U	0.076 U	0.082 U	0.099 U	0.078 U
1,3-Dichloropropane	8260B	ug/Kg	0.1 U	0.11 U	0.093 U	0.1 U	0.13 U	0.095 U
1,4-Dioxane	8260B	ug/Kg	16 U	19 UJ	17 UJ	19 UJ	22 UJ	18 UJ
2-Butanone (MEK)	8260B	ug/Kg	1.5 U	1.7 U	6.3 J	4.2 J	5.8 J	1.6 U
2-Chloro-1,3-butadiene (Chloroprene)	8260B	ug/Kg	0.2 U	0.24 U	0.22 U	0.23 U	0.28 U	0.22 U
2-Hexanone	8260B	ug/Kg	1.4 U	1.6 U	1.5 U	1.6 U	1.9 U	1.5 U
2-Methyl-1-propanol (Isobutyl Alcohol)	8260B	ug/Kg	25 U	30 UJ	27 UJ	29 UJ	35 UJ	28 UJ
3-Chloro-1-propene (Allyl Chloride)	8260B	ug/Kg	1 U	1.2 U	1.1 U	1.2 U	1.4 U	1.1 U
4-Methyl-2-pentanone (MIBK)	8260B	ug/Kg	0.94 U	1.1 U	1 U	1.1 U	1.3 U	1.1 U
Acetone	8260B	ug/Kg	3.3 U	11 J	40 J	29 J	42 J	14 J
Acetonitrile	8260B	ug/Kg	22 U	25 UJ	23 UJ	25 UJ	30 UJ	24 UJ
Acrolein	8260B	ug/Kg	8.5 U	9.9 UJ	9.1 UJ	9.7 UJ	12 UJ	9.3 UJ
Acrylonitrile	8260B	ug/Kg	8.2 U	9.6 UJ	8.8 UJ	9.4 UJ	12 UJ	9 UJ
Benzene	8260B	ug/Kg	0.11 U	0.13 U	0.12 U	0.12 U	0.15 U	0.12 U
Bromodichloromethane	8260B	ug/Kg	0.11 U	0.13 U	0.12 U	0.13 U	0.16 U	0.12 U
Bromoform	8260B	ug/Kg	0.15 U	0.17 U	0.16 U	0.17 U	0.21 U	0.16 U
Bromomethane	8260B	ug/Kg	0.16 U	0.19 U	0.17 U	0.19 U	0.22 U	0.18 U
Carbon Disulfide	8260B	ug/Kg	1.8 U	2.1 U	1.9 U	2 U	2.4 U	1.9 U
Carbon Tetrachloride	8260B	ug/Kg	0.19 U	0.22 U	0.2 U	0.22 U	0.26 U	0.21 U

Table B2 - Validated results of sediment sample analyses (continued)

Station			SD-01/SW-01	SD-02	SD-03/SW-02	SD-03/SW-02	SD-04	SD-05/SW-03
Sample			SD6001	SD6002	SD6003	SD6011	SD6004	SD6005
Date			10/14/04	10/18/04	10/18/04	10/18/04	10/18/04	10/18/04
Depth			0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In
Analyte	Method	Units	Field dup					
Chlorobenzene	8260B	ug/Kg	0.072 U	0.084 U	0.076 U	0.082 U	0.099 U	0.078 U
Chloroethane	8260B	ug/Kg	0.16 U	0.19 U	0.17 U	0.19 U	0.22 U	0.18 U
Chloroform	8260B	ug/Kg	0.089 U	0.11 U	0.095 U	0.11 U	0.13 U	0.097 U
Chloromethane	8260B	ug/Kg	0.25 U	0.3 U	0.27 U	0.29 U	0.35 U	0.28 U
cis-1,2-Dichloroethene	8260B	ug/Kg	0.14 U	0.13 U	0.12 U	0.13 U	0.16 U	0.13 U
cis-1,3-Dichloropropene	8260B	ug/Kg	0.056 U	0.065 U	0.06 U	0.064 U	0.077 U	0.061 U
Dibromochloromethane	8260B	ug/Kg	0.12 U	0.14 U	0.13 U	0.14 U	0.17 U	0.13 U
Dibromomethane	8260B	ug/Kg	0.14 U	0.16 U	0.15 U	0.16 U	0.19 U	0.15 U
Dichlorodifluoromethane (CFC 12)	8260B	ug/Kg	0.16 U	0.19 U	0.17 U	0.19 U	0.22 U	0.18 U
Dichloromethane (Methylene Chloride)	8260B	ug/Kg	0.27 U	31 U	26 U	27 U	36 U	29 U
Ethyl Methacrylate	8260B	ug/Kg	0.79 U	0.93 U	0.85 U	0.91 U	1.1 U	0.87 U
Ethylbenzene	8260B	ug/Kg	0.06 U	0.07 U	0.064 U	0.068 U	0.083 U	0.065 U
Iodomethane (Methyl Iodide)	8260B	ug/Kg	0.58 U	0.68 U	0.62 U	0.67 U	0.81 U	0.64 U
m,p-Xylenes	8260B	ug/Kg	0.16 U	0.19 U	0.17 U	0.19 U	0.22 U	0.18 U
Methacrylonitrile	8260B	ug/Kg	1.3 U	1.5 U	1.4 U	1.5 U	1.8 U	1.4 U
Methyl Methacrylate	8260B	ug/Kg	0.72 U	0.84 U	0.76 U	0.82 U	0.99 U	0.78 U
o-Xylene	8260B	ug/Kg	0.049 U	0.057 U	0.053 U	0.056 U	0.068 U	0.054 U
Propionitrile	8260B	ug/Kg	6.2 U	7.3 UJ	6.7 UJ	7.1 UJ	8.6 UJ	6.8 UJ
Styrene	8260B	ug/Kg	0.087 U	0.11 U	0.093 U	0.1 U	0.13 U	0.095 U
Tetrachloroethene (PCE)	8260B	ug/Kg	0.081 U	0.094 U	0.086 U	0.092 U	0.12 U	0.088 U
Toluene	8260B	ug/Kg	0.073 U	0.085 U	29 J	5.4 J	0.65 J	0.08 U
trans-1,2-Dichloroethene	8260B	ug/Kg	0.098 U	0.12 U	0.11 U	0.12 U	0.14 U	0.11 U
trans-1,3-Dichloropropene	8260B	ug/Kg	0.081 U	0.094 U	0.086 U	0.092 U	0.12 U	0.088 U
trans-1,4-Dichloro-2-butene	8260B	ug/Kg	0.48 U	0.56 U	0.51 U	0.55 U	0.66 U	0.52 U
Trichloroethene (TCE)	8260B	ug/Kg	0.15 U	0.17 U	0.16 U	0.17 U	0.21 U	0.16 U
Trichlorofluoromethane (CFC 11)	8260B	ug/Kg	0.13 U	0.15 U	0.13 U	0.14 U	0.17 U	0.14 U
Vinyl Acetate	8260B	ug/Kg	0.77 U	0.9 U	0.82 U	0.88 U	1.1 U	0.84 U
Vinyl Chloride	8260B	ug/Kg	0.095 U	0.12 U	0.11 U	0.11 U	0.14 U	0.11 U
Hexadecanoic acid	8270C TIC	ug/Kg	320 NJ	--	--	--	--	--
1-phenanthrenecarboxylic acid, 1,2,3,4,4	8270C TIC	ug/Kg	390 NJ	--	--	--	--	--
Hexadecane	8270C TIC	ug/Kg	460 NJ	--	--	--	--	--
.beta.-sitosterol	8270C TIC	ug/Kg	960 NJ	--	--	--	--	--
Ergostanol	8270C TIC	ug/Kg	540 NJ	--	--	--	--	--

Notes:

U - not detected at detection limit shown

UJ - estimated detection limit

J - estimated

B (metals) - estimated

NJ - the analyte is tentatively identified and the result is an estimate

TIC - tentatively identified compound

* - Result from Method 8270C selected ion monitoring (SIM) analysis

** - Result not available (See Quality Assurance Review memo for details)

Table B2 - Validated results of sediment sample analyses (continued)

Station			SD-06/SW-04	SD-07	SD-08/SW-05	SD-09	SD-10/SW-06
Sample			SD6006	SD6007	SD6008	SD6009	SD6010
Date			10/18/04	10/18/04	10/19/04	10/19/04	10/19/04
Depth			0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In
Analyte	Method	Units					
Carbon, Total Organic (TOC)	SID, S3	mg/Kg	23000	3600	15000 J	17000 J	12000 J
pH	9045C	PH	6.4 J	5.7 J	5.5	5.9	5.6
Solids, Total	160.3M	%	56.5	78.7	72.9	79.8	76.4
Cyanide, Total	9012A	mg/Kg	0.23 J	0.12	0.14	0.14 J	0.12
Antimony, Total	6020	mg/Kg	0.343 U	0.593 U	0.608 B	0.345 J	0.591 B
Arsenic, Total	6020	mg/Kg	1.34	1.19	4.72	1.08	3.02
Barium, Total	6020	mg/Kg	71.6	26.1	54.6	28.6	41.8
Beryllium, Total	6020	mg/Kg	0.891	0.231 U	0.281 B	0.228 U	0.24 U
Cadmium, Total	6020	mg/Kg	0.281 U	0.207 U	0.216 U	0.204 U	0.214 U
Chromium, Total	6020	mg/Kg	17	8.69	18.4	8.38	13.2
Cobalt, Total	6020	mg/Kg	2.11	1.7	2.72	1.74	1.54
Copper, Total	6020	mg/Kg	8.54	3.55	11.5	4.49	10.2
Lead, Total	6020	mg/Kg	21.6	6.93	38.7	11	40.1
Mercury, Total	7471	mg/Kg	0.066 B	0.015 B	0.184	0.038 B	0.049 B
Nickel, Total	6020	mg/Kg	6.39	4.07	7.19	3.17	4.92
Selenium, Total	6020	mg/Kg	0.728 U	0.535 U	0.56 U	0.529 U	0.555 U
Silver, Total	6020	mg/Kg	0.274 B	0.069 B	0.075 B	0.028 B	0.093 B
Thallium, Total	6020	mg/Kg	0.214 U	0.108 U	0.229 B	0.338 B	0.163 B
Tin, Total	6020	mg/Kg	2.06 U	1.34 U	28.6	2.13 U	4.36
Vanadium, Total	6020	mg/Kg	21.2	14.7	37.3	16.7	26.1
Zinc, Total	6020	mg/Kg	35.6	10.9	61.2	32	52.3
2,4,5-T	8151A	ug/Kg	4 U	1.6 U	0.8 U	0.8 U	0.8 U
2,4,5-TP (Silvex)	8151A	ug/Kg	3.5 U	1.4 U	0.7 U	0.7 U	0.7 U
2,4-D	8151A	ug/Kg	44 U	18 U	8.8 U	8.8 U	8.8 U
4,4'-DDD	8081A	ug/Kg	1.3 U	0.59 U	0.64 U	0.58 U	0.61 U
4,4'-DDE	8081A	ug/Kg	0.38 U	0.18 U	0.2 U	0.18 U	0.19 U
4,4'-DDT	8081A	ug/Kg	0.41 UJ	0.19 UJ	0.21 U	0.19 U	0.2 U
Aldrin	8081A	ug/Kg	0.57 U	0.27 U	0.29 U	0.27 U	0.28 U
alpha-BHC	8081A	ug/Kg	0.49 UJ	0.23 UJ	0.25 U	0.23 U	0.24 U
alpha-Chlordane	8081A	ug/Kg	0.38 UJ	0.18 UJ	0.2 U	0.18 U	0.19 U
Aroclor 1016	8082A	ug/Kg	25 U	12 U	13 U	12 U	13 U
Aroclor 1221	8082A	ug/Kg	53 U	26 U	28 U	26 U	27 U
Aroclor 1232	8082A	ug/Kg	40 U	19 U	21 U	19 U	20 U
Aroclor 1242	8082A	ug/Kg	15 U	6.9 U	7.6 U	6.9 U	7.2 U
Aroclor 1248	8082A	ug/Kg	18 U	8.6 U	9.4 U	8.6 U	9 U

Table B2 - Validated results of sediment sample analyses (continued)

Station			SD-06/SW-04	SD-07	SD-08/SW-05	SD-09	SD-10/SW-06
Sample			SD6006	SD6007	SD6008	SD6009	SD6010
Date			10/18/04	10/18/04	10/19/04	10/19/04	10/19/04
Depth			0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In
Analyte	Method	Units					
Aroclor 1254	8082A	ug/Kg	14 U	6.3 U	6.9 U	6.3 U	6.6 U
Aroclor 1260	8082A	ug/Kg	7.2 U	3.4 U	3.8 U	3.4 U	3.6 U
beta-BHC	8081A	ug/Kg	0.73 UJ	0.35 UJ	0.38 U	0.34 U	0.36 U
delta-BHC	8081A	ug/Kg	0.38 UJ	0.18 UJ	0.2 U	0.18 U	0.19 U
Dieldrin	8081A	ug/Kg	0.73 U	0.35 U	0.38 U	0.34 U	0.36 U
Endosulfan I	8081A	ug/Kg	0.46 U	0.22 U	0.24 U	0.22 U	0.23 U
Endosulfan II	8081A	ug/Kg	0.57 UJ	0.27 UJ	0.29 U	0.27 U	0.28 U
Endosulfan Sulfate	8081A	ug/Kg	0.51 UJ	0.25 UJ	0.27 U	0.24 U	0.25 U
Endrin	8081A	ug/Kg	0.54 UJ	0.26 UJ	0.28 U	0.26 U	0.27 U
Endrin Aldehyde	8081A	ug/Kg	0.54 UJ	0.26 UJ	0.28 U	0.26 U	0.27 U
Endrin Ketone	8081A	ug/Kg	0.84 UJ	0.4 UJ	0.43 U	0.39 U	0.41 U
gamma-BHC (Lindane)	8081A	ug/Kg	1.6 UJ	0.75 UJ	0.81 U	0.74 U	0.78 U
gamma-Chlordane	8081A	ug/Kg	2 UJ	0.93 UJ	1.1 U	0.92 U	0.96 U
Heptachlor	8081A	ug/Kg	1.3 UJ	0.6 UJ	0.65 U	0.59 U	0.62 U
Heptachlor Epoxide	8081A	ug/Kg	0.43 UJ	0.21 UJ	0.22 U	0.21 U	0.21 U
Methoxychlor	8081A	ug/Kg	0.43 UJ	0.21 UJ	0.22 U	0.21 U	0.21 U
Toxaphene	8081A	ug/Kg	92 U	44 U	47 U	43 U	45 U
Azinphos-methyl (Guthion)	8141A	ug/kg	12 U	8.1 U	8.8 U	8.8 U	8.4 U
Bolstar (Sulprofos)	8141A	ug/kg	16 U	12 U	13 U	13 U	12 U
Chlorpyrifos	8141A	ug/kg	48 U	35 U	38 U	38 U	36 U
Coumaphos	8141A	ug/kg	14 U	9.8 U	11 U	11 U	11 U
Demeton-O,S	8141A	ug/kg	22 U	16 U	17 U	17 U	17 U
Diazinon	8141A	ug/kg	13 U	9.2 U	10 U	10 U	9.6 U
Dichlorvos	8141A	ug/kg	18 U	13 U	14 U	14 U	14 U
Dimethoate	8141A	ug/kg	52 U	37 U	41 U	41 U	39 U
Disulfoton	8141A	ug/kg	41 U	30 U	32 U	32 U	31 UJ
EPN	8141A	ug/kg	15 U	11 U	12 U	12 U	12 U
Ethoprop (Prophos)	8141A	ug/kg	13 U	8.9 U	9.8 U	9.7 U	9.4 U
Fensulfothion	8141A	ug/kg	20 U	14 U	16 U	16 U	15 U
Fenthion	8141A	ug/kg	15 U	11 U	12 U	12 U	12 U
Malathion	8141A	ug/kg	14 U	9.7 U	11 U	11 U	11 U
Merphos	8141A	ug/kg	7.1 U	5.1 U	5.6 U	5.6 U	5.4 U
Methyl Parathion	8141A	ug/kg	15 U	11 U	12 U	12 U	12 U
Mevinphos	8141A	ug/kg	16 U	11 U	12 U	12 U	12 U
Parathion	8141A	ug/kg	15 U	11 U	12 U	12 U	12 U

Table B2 - Validated results of sediment sample analyses (continued)

Station			SD-06/SW-04	SD-07	SD-08/SW-05	SD-09	SD-10/SW-06
Sample			SD6006	SD6007	SD6008	SD6009	SD6010
Date			10/18/04	10/18/04	10/19/04	10/19/04	10/19/04
Depth			0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In
Analyte	Method	Units					
Phorate	8141A	ug/kg	39 U	28 U	31 U	31 U	30 U
Ronnel	8141A	ug/kg	15 U	11 U	12 U	12 U	11 U
Stirophos (Tetrachlorovinphos)	8141A	ug/kg	13 U	8.8 U	9.6 U	9.6 U	9.2 U
Sulfotep	8141A	ug/kg	14 U	9.6 U	11 U	11 U	10 U
Tokuthion (Prothiofos)	8141A	ug/kg	14 U	9.8 U	11 U	11 U	11 U
Trichloronate	8141A	ug/kg	50 U	36 U	39 U	39 U	38 U
1,2,4-Trichlorobenzene	8270C	ug/Kg	25 U	18 U	20 U	18 U	19 U
1,2-Dichlorobenzene	8270C	ug/Kg	34 U	24 U	27 U	24 U	25 U
1,3-Dichlorobenzene	8270C	ug/Kg	30 U	22 U	24 U	22 U	23 U
1,4-Dichlorobenzene	8270C	ug/Kg	34 U	24 U	27 U	24 U	25 U
1-Methylnaphthalene	8270C	ug/Kg	25 U	18 U	20 U	18 U	19 U
2,4,5-Trichlorophenol	8270C	ug/Kg	23 U	17 U	18 U	17 U	18 U
2,4,6-Trichlorophenol	8270C	ug/Kg	64 U	46 U	50 U	46 U	48 U
2,4-Dichlorophenol	8270C	ug/Kg	30 U	22 U	24 U	22 U	23 U
2,4-Dimethylphenol	8270C	ug/Kg	34 U	24 U	27 U	24 U	25 U
2,4-Dinitrophenol	8270C	ug/Kg	22 U	16 U	17 U	16 U	16 U
2,4-Dinitrotoluene	8270C	ug/Kg	18 U	13 U	14 U	13 U	13 U
2,6-Dinitrotoluene	8270C	ug/Kg	64 U	46 U	50 U	46 U	48 U
2-Chloronaphthalene	8270C	ug/Kg	29 U	21 U	22 U	21 U	21 U
2-Chlorophenol	8270C	ug/Kg	32 U	23 U	25 U	23 U	24 U
2-Methylnaphthalene	8270C	ug/Kg	27 U	19 U	21 U	19 U	20 U
2-Methylphenol	8270C	ug/Kg	22 U	16 U	17 U	16 U	16 U
2-Nitroaniline	8270C	ug/Kg	39 U	28 U	31 U	28 U	29 U
2-Nitrophenol	8270C	ug/Kg	25 U	18 U	20 U	18 U	19 U
3,3'-Dichlorobenzidine	8270C	ug/Kg	60 U	43 U	47 U	43 U	45 U
3-Nitroaniline	8270C	ug/Kg	30 U	22 U	24 U	22 U	23 U
4,6-Dinitro-2-methylphenol	8270C	ug/Kg	17 U	12 U	13 U	12 U	13 U
4-Bromophenyl Phenyl Ether	8270C	ug/Kg	18 U	13 U	14 U	13 U	13 U
4-Chloro-3-methylphenol	8270C	ug/Kg	29 U	21 U	22 U	21 U	21 U
4-Chloroaniline	8270C	ug/Kg	46 U	33 U	36 U	33 U	35 U
4-Chlorophenyl Phenyl Ether	8270C	ug/Kg	39 U	28 U	31 U	28 U	29 U
4-Methylphenol	8270C	ug/Kg	46 U	33 U	36 U	33 U	35 U
4-Nitroaniline	8270C	ug/Kg	22 U	16 U	17 U	16 U	16 U
4-Nitrophenol	8270C	ug/Kg	30 U	22 U	24 U	22 U	23 U
Acenaphthene	8270C	ug/Kg	34 U	24 U	27 U	24 U	25 U

Table B2 - Validated results of sediment sample analyses (continued)

Station			SD-06/SW-04	SD-07	SD-08/SW-05	SD-09	SD-10/SW-06
Sample			SD6006	SD6007	SD6008	SD6009	SD6010
Date			10/18/04	10/18/04	10/19/04	10/19/04	10/19/04
Depth			0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In
Analyte	Method	Units					
Acenaphthylene	8270C	ug/Kg	34 U	24 U	27 U	24 U	25 U
Acetophenone	8270C	ug/Kg	150 U	110 U	120 U	110 U	110 U
Anthracene	8270C	ug/Kg	20 U	14 U	16 U	14 U	15 U
Benz(a)anthracene	8270C	ug/Kg	20 U	14 U	16 U	14 U	21 J
Benzo(a)pyrene	8270C	ug/Kg	34 U	24 U	27 U	24 U	25 U
Benzo(b)fluoranthene	8270C	ug/Kg	36 U	26 U	28 U	26 U	27 U
Benzo(g,h,i)perylene	8270C	ug/Kg	29 U	21 U	22 U	21 U	36 J
Benzo(k)fluoranthene	8270C	ug/Kg	29 U	21 U	22 U	21 U	21 U
Benzyl Alcohol	8270C	ug/Kg	39 U	28 U	31 U	28 U	29 U
Bis(2-chloroethoxy)methane	8270C	ug/Kg	30 U	22 U	24 U	22 U	23 U
Bis(2-chloroethyl) Ether	8270C	ug/Kg	27 U	19 U	21 U	19 U	20 U
Bis(2-chloroisopropyl) Ether	8270C	ug/Kg	37 U	27 U	29 U	27 U	28 U
Bis(2-ethylhexyl) Phthalate	8270C	ug/Kg	29 U	21 U	22 U	21 U	21 U
Butyl Benzyl Phthalate	8270C	ug/Kg	32 U	23 U	25 U	23 U	24 U
Carbazole	8270C	ug/Kg	29 U	21 U	22 U	21 U	21 U
Chrysene	8270C	ug/Kg	39 U	28 U	31 U	28 U	29 U
Dibenz(a,h)anthracene	8270C	ug/Kg	39 U	28 U	31 U	28 U	29 U
Dibenzofuran	8270C	ug/Kg	23 U	17 U	18 U	17 U	18 U
Diethyl Phthalate	8270C	ug/Kg	22 U	16 U	17 U	16 U	16 U
Dimethyl Phthalate	8270C	ug/Kg	18 U	13 U	14 U	13 U	13 U
Di-n-butyl Phthalate	8270C	ug/Kg	110 U	77 U	84 U	77 U	80 U
Di-n-octyl Phthalate	8270C	ug/Kg	27 U	19 U	21 U	19 U	20 U
Fluoranthene	8270C	ug/Kg	22 U	16 U	17 U	16 U	25 J
Fluorene	8270C	ug/Kg	18 U	13 U	14 U	13 U	14 U
Hexachlorobenzene	8270C	ug/Kg	15 U	11 U	12 U	11 U	11 U
Hexachlorobutadiene	8270C	ug/Kg	30 U	22 U	24 U	22 U	23 U
Hexachlorocyclopentadiene	8270C	ug/Kg	20 U	14 U	16 U	14 U	15 U
Hexachloroethane	8270C	ug/Kg	30 U	22 U	24 U	22 U	23 U
Indeno(1,2,3-cd)pyrene	8270C	ug/Kg	32 U	23 U	25 U	23 U	24 U
Isophorone	8270C	ug/Kg	23 U	17 U	18 U	17 U	18 U
Naphthalene	8270C	ug/Kg	23 U	17 U	18 U	17 U	18 U
Nitrobenzene	8270C	ug/Kg	36 U	26 U	28 U	26 U	27 U
N-Nitrosodi-n-propylamine	8270C	ug/Kg	32 U	23 U	25 U	23 U	24 U
N-Nitrosodiphenylamine	8270C	ug/Kg	20 U	14 U	16 U	14 U	15 U
Pentachlorophenol (PCP)	8270C	ug/Kg	41 U	29 U	32 U	29 U	31 U

Table B2 - Validated results of sediment sample analyses (continued)

Station			SD-06/SW-04	SD-07	SD-08/SW-05	SD-09	SD-10/SW-06
Sample			SD6006	SD6007	SD6008	SD6009	SD6010
Date			10/18/04	10/18/04	10/19/04	10/19/04	10/19/04
Depth			0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In
Analyte	Method	Units					
Phenanthrene	8270C	ug/Kg	23 U	17 U	18 U	17 U	18 U
Phenol	8270C	ug/Kg	29 U	21 U	22 U	21 U	21 U
Pyrene	8270C	ug/Kg	25 U	18 U	20 U	18 U	22 J
1,2-Dichlorobenzene	8260B	ug/Kg	0.14 U	0.098 U	0.11 U	0.098 U	0.11 U
1,3-Dichlorobenzene	8260B	ug/Kg	0.088 U	0.063 U	0.069 U	0.063 U	0.068 U
1,4-Dichlorobenzene	8260B	ug/Kg	0.16 U	0.11 U	0.12 U	0.11 U	0.12 U
1,1,1,2-Tetrachloroethane	8260B	ug/Kg	0.11 U	0.074 U	0.081 U	0.074 U	0.08 U
1,1,1-Trichloroethane (TCA)	8260B	ug/Kg	0.22 U	0.16 U	0.17 U	0.16 U	0.17 U
1,1,2,2-Tetrachloroethane	8260B	ug/Kg	0.12 U	0.083 U	0.091 U	0.083 U	0.09 U
1,1,2-Trichloroethane	8260B	ug/Kg	0.23 U	0.17 U	0.18 U	0.17 U	0.18 U
1,1-Dichloroethane (1,1-DCA)	8260B	ug/Kg	0.12 U	0.079 U	0.087 U	0.079 U	0.086 U
1,1-Dichloroethene (1,1-DCE)	8260B	ug/Kg	0.3 U	0.22 U	0.24 U	0.22 U	0.23 U
1,2,3-Trichloropropane	8260B	ug/Kg	0.3 U	0.22 U	0.24 U	0.22 U	0.23 U
1,2-Dibromo-3-chloropropane (DBCP)	8260B	ug/Kg	0.86 U	0.62 U	0.68 U	0.62 U	0.67 U
1,2-Dibromoethane (EDB)	8260B	ug/Kg	0.099 U	0.071 U	0.077 U	0.071 U	0.076 U
1,2-Dichloroethane (EDC)	8260B	ug/Kg	0.18 U	0.13 U	0.14 U	0.13 U	0.14 U
1,2-Dichloropropane	8260B	ug/Kg	0.095 U	0.068 U	0.075 U	0.068 U	0.073 U
1,3-Dichloropropane	8260B	ug/Kg	0.12 U	0.083 U	0.091 U	0.083 U	0.09 U
1,4-Dioxane	8260B	ug/Kg	22 UJ	16 UJ	17 U	16 U	17 U
2-Butanone (MEK)	8260B	ug/Kg	3.1 J	1.4 U	1.6 U	1.4 U	1.5 U
2-Chloro-1,3-butadiene (Chloroprene)	8260B	ug/Kg	0.27 U	0.19 U	0.21 U	0.19 U	0.21 U
2-Hexanone	8260B	ug/Kg	1.8 U	1.3 U	1.4 U	1.3 U	1.4 U
2-Methyl-1-propanol (Isobutyl Alcohol)	8260B	ug/Kg	34 UJ	24 UJ	27 U	24 U	26 U
3-Chloro-1-propene (Allyl Chloride)	8260B	ug/Kg	1.4 U	0.96 U	1.1 U	0.96 U	1.1 U
4-Methyl-2-pentanone (MIBK)	8260B	ug/Kg	1.3 U	0.89 U	0.98 U	0.89 U	0.96 U
Acetone	8260B	ug/Kg	22 J	8 J	7.2 J	3.2 U	3.4 U
Acetonitrile	8260B	ug/Kg	29 UJ	21 UJ	22 U	21 U	22 U
Acrolein	8260B	ug/Kg	12 UJ	8.1 UJ	8.8 U	8.1 U	8.7 U
Acrylonitrile	8260B	ug/Kg	11 UJ	7.8 UJ	8.6 U	7.8 U	8.4 U
Benzene	8260B	ug/Kg	0.14 U	0.099 U	0.11 U	0.099 U	0.11 U
Bromodichloromethane	8260B	ug/Kg	0.15 U	0.11 U	0.12 U	0.11 U	0.12 U
Bromoform	8260B	ug/Kg	0.2 U	0.14 U	0.16 U	0.14 U	0.15 U
Bromomethane	8260B	ug/Kg	0.22 U	0.16 U	0.17 U	0.16 U	0.17 U
Carbon Disulfide	8260B	ug/Kg	2.3 U	1.7 U	1.8 U	1.7 U	1.8 U
Carbon Tetrachloride	8260B	ug/Kg	0.25 U	0.18 U	0.2 U	0.18 U	0.19 U

Table B2 - Validated results of sediment sample analyses (continued)

Station			SD-06/SW-04	SD-07	SD-08/SW-05	SD-09	SD-10/SW-06
Sample			SD6006	SD6007	SD6008	SD6009	SD6010
Date			10/18/04	10/18/04	10/19/04	10/19/04	10/19/04
Depth			0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In	0 - 6 In
Analyte	Method	Units					
Chlorobenzene	8260B	ug/Kg	0.095 U	0.068 U	0.075 U	0.068 U	0.073 U
Chloroethane	8260B	ug/Kg	0.22 U	0.16 U	0.17 U	0.16 U	0.17 U
Chloroform	8260B	ug/Kg	0.12 U	0.084 U	0.092 U	0.084 U	0.091 U
Chloromethane	8260B	ug/Kg	0.34 U	0.24 U	0.27 U	0.24 U	0.26 U
cis-1,2-Dichloroethene	8260B	ug/Kg	0.15 U	0.11 U	0.12 U	0.11 U	0.12 U
cis-1,3-Dichloropropene	8260B	ug/Kg	0.074 U	0.053 U	0.058 U	0.053 U	0.057 U
Dibromochloromethane	8260B	ug/Kg	0.16 U	0.12 U	0.13 U	0.12 U	0.13 U
Dibromomethane	8260B	ug/Kg	0.18 U	0.13 U	0.14 U	0.13 U	0.14 U
Dichlorodifluoromethane (CFC 12)	8260B	ug/Kg	0.22 U	0.16 U	0.17 U	0.16 U	0.17 U
Dichloromethane (Methylene Chloride)	8260B	ug/Kg	30 U	23 U	28 U	23 U	27 U
Ethyl Methacrylate	8260B	ug/Kg	1.1 U	0.76 U	0.83 U	0.76 UJ	0.81 U
Ethylbenzene	8260B	ug/Kg	0.079 U	0.057 U	0.062 U	0.057 U	0.061 U
Iodomethane (Methyl Iodide)	8260B	ug/Kg	0.78 U	0.56 U	0.61 U	0.56 U	0.6 U
m,p-Xylenes	8260B	ug/Kg	0.22 U	0.16 U	0.17 U	0.16 U	0.17 U
Methacrylonitrile	8260B	ug/Kg	1.7 U	1.2 U	1.4 U	1.2 U	1.3 U
Methyl Methacrylate	8260B	ug/Kg	0.95 U	0.68 U	0.75 U	0.68 U	0.73 U
o-Xylene	8260B	ug/Kg	0.065 U	0.047 U	0.051 U	0.047 U	0.05 U
Propionitrile	8260B	ug/Kg	8.3 UJ	5.9 UJ	6.5 U	5.9 U	6.4 U
Styrene	8260B	ug/Kg	0.12 U	0.083 U	0.091 U	0.083 U	0.09 U
Tetrachloroethene (PCE)	8260B	ug/Kg	0.11 U	0.077 U	0.084 U	0.077 U	0.083 U
Toluene	8260B	ug/Kg	3.7 J	0.069 U	0.076 U	0.069 U	0.075 U
trans-1,2-Dichloroethene	8260B	ug/Kg	0.13 U	0.093 U	0.11 U	0.093 U	0.1 U
trans-1,3-Dichloropropene	8260B	ug/Kg	0.11 U	0.077 U	0.084 U	0.077 U	0.083 U
trans-1,4-Dichloro-2-butene	8260B	ug/Kg	0.64 U	0.46 U	0.5 U	0.46 U	0.49 U
Trichloroethene (TCE)	8260B	ug/Kg	0.2 U	0.14 U	0.16 U	0.14 U	0.15 U
Trichlorofluoromethane (CFC 11)	8260B	ug/Kg	0.17 U	0.12 U	0.13 U	0.12 U	0.13 U
Vinyl Acetate	8260B	ug/Kg	1.1 U	0.73 U	0.8 U	0.73 R	0.79 U
Vinyl Chloride	8260B	ug/Kg	0.13 U	0.091 U	0.099 U	0.091 U	0.098 U
Hexadecanoic acid	8270C TIC	ug/Kg	--	--	--	--	--
1-phenanthrenecarboxylic acid, 1,2,3,4,	8270C TIC	ug/Kg	--	--	--	--	--
Hexadecane	8270C TIC	ug/Kg	--	--	--	--	--
.beta.-sitosterol	8270C TIC	ug/Kg	--	--	--	--	--
Ergostanol	8270C TIC	ug/Kg	--	--	--	--	--

Notes:

U - not detected at detection limit shown

UJ - estimated detection limit

J - estimated

B (metals) - estimated

NJ - the analyte is tentatively identified and the result is an estimate

TIC - tentatively identified compound

* - Result from Method 8270C selected ion monitoring (SIM) analysis

Table B3 - Validated results of surface water sample analyses

Station			SD-01/SW-01	SD-03/SW-02	SD-05/SW-03	SD-06/SW-04	SD-08/SW-05	SD-08/SW-05	SD-10/SW-06
Sample			SW6001	SW6002	SW6003	SW6004	SW6005	SW6007	SW6006
Date			10/14/04	10/18/04	10/18/04	10/18/04	10/19/04	10/19/04	10/19/04
Analyte	Method	Units	Field dup						
Cyanide, Total	9012A	mg/L	0.0024	0.0024	0.0024	0.0024	0.0024 U	0.0024 U	0.02 J
Antimony, Total	6020	mg/L	0.000236 B	0.00015 U	0.00015 U	0.00015 U	0.000342 B	0.00015 U	0.00053 B
Arsenic, Total	6020	mg/L	0.00343	0.00285	0.016	0.00163	0.00367	0.0033	0.00321
Barium, Total	6020	mg/L	0.0128	0.0103	0.0285	0.0223	0.0418	0.0414	0.0332
Beryllium, Total	6020	mg/L	0.00007 B	0.00007 U	0.00007 U	0.00007 U	0.00007 U	0.00007 U	0.000088 B
Cadmium, Total	6020	mg/L	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.000269 B
Chromium, Hexavalent, Total	7196A	mg/L	0.003	0.5 UJ	0.5 UJ	0.5 UJ	0.003 UJ	0.003 UJ	0.003 UJ
Chromium, Total	6020	mg/L	0.00326	0.00172 B	0.00633	0.00109 U	0.00124 U	0.00139 U	0.00504
Cobalt, Total	6020	mg/L	0.000419 B	0.000457 B	0.00124	0.000913 B	0.000876 B	0.000778 B	0.00107
Copper, Total	6020	mg/L	0.00253	0.000874 B	0.00233	0.001 U	0.0044	0.0033	0.033
Lead, Total	6020	mg/L	0.00128	0.000761 B	0.00106	0.00114	0.00211	0.00208	0.0139
Mercury, Total	7470	mg/L	0.00013 U	0.00013 UJ	0.00013 UJ	0.00013 UJ	0.00013 U	0.00013 U	0.00013 U
Nickel, Total	6020	mg/L	0.00112 B	0.000558 B	0.000799 B	0.000833 U	0.00118 B	0.0013 B	0.00418
Selenium, Total	6020	mg/L	0.00095 U	0.00095 U	0.00095 U	0.00095 U	0.00095 U	0.00095 U	0.00095 U
Silver, Total	6020	mg/L	0.000044 B	0.00004 U	0.00004 U	0.00004 U	0.00004 U	0.000052 B	0.000112 B
Thallium, Total	6020	mg/L	0.000217 B	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.00013 U	0.000139 B
Tin, Total	6020	mg/L	0.000211 B	0.00011 U	0.00011 U	0.00011 U	0.000194 J	0.000301 J	0.00215 B
Vanadium, Total	6020	mg/L	0.00275 B	0.00225 B	0.00196 B	0.00145 B	0.00235 B	0.00222 B	0.00811 B
Zinc, Total	6020	mg/L	0.0143	0.0063 B	0.0105	0.0133 U	0.0315 J	0.0452 J	0.111
1,2,4,5-Tetrachlorobenzene	8270C	ug/L	1.4 U	1.5 U	1.4 U	1.6 U	1.4 U	1.4 U	1.4 U
1,2,4-Trichlorobenzene	8270C	ug/L	0.41 U	0.42 U	0.41 U	0.45 U	0.41 U	0.41 U	0.41 U
1,2-Dichlorobenzene	8270C	ug/L	0.51 U	0.53 U	0.51 U	0.56 U	0.51 U	0.51 U	0.51 U
1,3,5-Trinitrobenzene	8270C	ug/L	3 U	3.1 U	3 U	3.3 U	3 U	3 U	3 U
1,3-Dichlorobenzene	8270C	ug/L	0.42 U	0.43 U	0.42 U	0.46 U	0.42 U	0.42 U	0.42 U
1,3-Dinitrobenzene	8270C	ug/L	5.5 U	5.7 U	5.5 U	6 U	5.5 U	5.5 U	5.5 U
1,4-Dichlorobenzene	8270C	ug/L	0.54 U	0.56 U	0.54 U	0.59 U	0.54 U	0.54 U	2.3 J
1,4-Naphthoquinone	8270C	ug/L	7.2 U	7.4 U	7.2 U	7.9 U	7.2 U	7.2 U	7.2 U
1,4-Phenylenediamine	8270C	ug/L	20 U	21 U	20 U	22 U	20 U	20 U	20 U
1-Naphthylamine	8270C	ug/L	0.93 U	0.95 U	0.93 U	1.1 U	0.93 U	0.93 U	0.93 U
2,3,4,6-Tetrachlorophenol	8270C	ug/L	0.46 U	0.47 U	0.46 U	0.5 U	0.46 U	0.46 U	0.46 U
2,4,5-Trichlorophenol	8270C	ug/L	0.41 U	0.42 U	0.41 U	0.45 U	0.41 U	0.41 U	0.41 U
2,4,6-Trichlorophenol	8270C	ug/L	0.4 U	0.41 U	0.4 U	0.44 U	0.4 U	0.4 U	0.4 U
2,4-Dichlorophenol	8270C	ug/L	0.41 U	0.42 U	0.41 U	0.45 U	0.41 U	0.41 U	0.41 U
2,4-Dimethylphenol	8270C	ug/L	0.53 U	0.55 U	0.53 U	0.58 U	0.53 U	0.53 U	0.53 U
2,4-Dinitrophenol	8270C	ug/L	0.72 U	0.74 U	0.72 U	0.79 U	0.72 U	0.72 U	0.72 U
2,4-Dinitrotoluene	8270C	ug/L	0.39 U	0.4 U	0.39 U	0.43 U	0.39 U	0.39 U	0.39 U

Table B3 - Validated results of surface water sample analyses (continued)

Station		SD-01/SW-01	SD-03/SW-02	SD-05/SW-03	SD-06/SW-04	SD-08/SW-05	SD-08/SW-05	SD-10/SW-06
Sample		SW6001	SW6002	SW6003	SW6004	SW6005	SW6007	SW6006
Date		10/14/04	10/18/04	10/18/04	10/18/04	10/19/04	10/19/04	10/19/04
Analyte	Method Units						Field dup	
2,6-Dichlorophenol	8270C ug/L	1.2 U	1.3 U	1.2 U	1.4 U	1.2 U	1.2 U	1.2 U
2,6-Dinitrotoluene	8270C ug/L	0.5 U	0.52 U	0.5 U	0.55 U	0.5 U	0.5 U	0.5 U
2-Acetylaminofluorene	8270C ug/L	1.9 U	2 U	1.9 U	2.1 U	1.9 U	1.9 U	1.9 U
2-Chloronaphthalene	8270C ug/L	0.44 U	0.45 U	0.44 U	0.48 U	0.44 U	0.44 U	0.44 U
2-Chlorophenol	8270C ug/L	0.48 U	0.49 U	0.48 U	0.53 U	0.48 U	0.48 U	0.48 U
2-Methyl-5-nitroaniline	8270C ug/L	1.4 U	1.5 U	1.4 U	1.6 U	1.4 U	1.4 U	1.4 U
2-Methylnaphthalene	8270C ug/L	0.42 U	0.43 U	0.42 U	0.46 U	0.42 U	0.42 U	0.42 U
2-Methylphenol	8270C ug/L	0.44 U	0.45 U	0.44 U	0.48 U	0.44 U	0.44 U	0.44 U
2-Naphthylamine	8270C ug/L	1 U	1.1 U	1 U	1.1 U	1 U	1 U	1 U
2-Nitroaniline	8270C ug/L	0.3 U	0.31 U	0.3 U	0.33 U	0.3 U	0.3 U	0.3 U
2-Nitrophenol	8270C ug/L	0.47 U	0.48 U	0.47 U	0.52 U	0.47 U	0.47 U	0.47 U
2-Picoline	8270C ug/L	0.5 U	0.52 U	0.5 U	0.55 U	0.5 U	0.5 U	0.5 U
3,3'-Dichlorobenzidine	8270C ug/L	0.61 U	0.63 U	0.61 U	0.67 U	0.61 U	0.61 U	0.61 U
3,3'-Dimethylbenzidine	8270C ug/L	0.6 U	0.62 UJ	0.6 UJ	0.66 UJ	0.6 U	0.6 U	0.6 U
3-Methylcholanthrene	8270C ug/L	1.5 U	1.6 U	1.5 U	1.7 U	1.5 U	1.5 U	1.5 U
3-Nitroaniline	8270C ug/L	0.26 U	0.27 U	0.26 U	0.29 U	0.26 U	0.26 U	0.26 U
4,6-Dinitro-2-methylphenol	8270C ug/L	0.32 U	0.33 U	0.32 U	0.35 U	0.32 U	0.32 U	0.32 U
4-Aminobiphenyl	8270C ug/L	1.2 U	1.3 U	1.2 U	1.4 U	1.2 U	1.2 U	1.2 U
4-Bromophenyl Phenyl Ether	8270C ug/L	0.26 U	0.27 U	0.26 U	0.29 U	0.26 U	0.26 U	0.26 U
4-Chloro-3-methylphenol	8270C ug/L	0.51 U	0.53 U	0.51 U	0.56 U	0.51 U	0.51 U	0.51 U
4-Chloroaniline	8270C ug/L	0.37 U	0.38 U	0.37 U	0.41 U	0.37 U	0.37 U	0.37 U
4-Chlorophenyl Phenyl Ether	8270C ug/L	0.36 U	0.37 U	0.36 U	0.4 U	0.36 U	0.36 U	0.36 U
4-Methylphenol	8270C ug/L	0.73 U	0.75 U	0.73 U	0.8 U	0.73 U	0.73 U	29 J
4-Nitroaniline	8270C ug/L	0.26 U	0.27 U	0.26 U	0.29 U	0.26 U	0.26 U	0.26 U
4-Nitrophenol	8270C ug/L	0.57 U	0.59 U	0.57 U	0.62 U	0.57 U	0.57 U	0.57 U
4-Nitroquinoline N-Oxide	8270C ug/L	1.7 U	1.8 U	1.7 U	1.9 U	1.7 U	1.7 U	1.7 U
7,12-Dimethylbenz(a)anthracene	8270C ug/L	1.4 U	1.5 U	1.4 U	1.6 U	1.4 U	1.4 U	1.4 U
a,a-Dimethylphenethylamine	8270C ug/L	1.9 U	2 U	1.9 U	2.1 U	1.9 U	1.9 U	1.9 U
Acenaphthene	8270C ug/L	0.32 U	0.33 U	0.32 U	0.35 U	0.32 U	0.32 U	0.32 U
Acenaphthylene	8270C ug/L	0.34 U	0.35 U	0.34 U	0.37 U	0.34 U	0.34 U	0.34 U
Acetophenone	8270C ug/L	5.6 U	5.8 U	5.6 U	6.1 U	5.6 U	5.6 U	5.6 U
Aniline	8270C ug/L	0.39 U	0.4 UJ	0.39 UJ	0.43 UJ	0.39 U	0.39 U	0.39 U
Anthracene	8270C ug/L	0.26 U	0.27 U	0.26 U	0.29 U	0.26 U	0.26 U	0.26 U
Aramite, Total	8270C ug/L	8.4 U	8.6 U	8.4 U	9.2 U	8.4 U	8.4 U	8.4 U
Benz(a)anthracene	8270C ug/L	0.56 U	0.58 U	0.56 U	0.61 U	0.56 U	0.56 U	0.56 U
Benzo(a)pyrene	8270C ug/L	0.55 U	0.57 U	0.55 U	0.6 U	0.55 U	0.55 U	0.55 U

Table B3 - Validated results of surface water sample analyses (continued)

Station		SD-01/SW-01	SD-03/SW-02	SD-05/SW-03	SD-06/SW-04	SD-08/SW-05	SD-08/SW-05	SD-10/SW-06
Sample		SW6001	SW6002	SW6003	SW6004	SW6005	SW6007	SW6006
Date		10/14/04	10/18/04	10/18/04	10/18/04	10/19/04	10/19/04	10/19/04
Analyte	Method Units						Field dup	
Benzo(b)fluoranthene	8270C ug/L	0.58 U	0.6 U	0.58 U	0.64 U	0.58 U	0.58 U	0.58 U
Benzo(g,h,i)perylene	8270C ug/L	0.49 U	0.5 U	0.49 U	0.54 U	0.49 U	0.49 U	0.49 U
Benzo(k)fluoranthene	8270C ug/L	0.57 U	0.59 U	0.57 U	0.62 U	0.57 U	0.57 U	0.57 U
Benzyl Alcohol	8270C ug/L	0.42 U	0.43 U	0.42 U	0.46 U	0.42 U	0.42 U	18 J
Bis(2-chloroethoxy)methane	8270C ug/L	0.45 U	0.46 U	0.45 U	0.49 U	0.45 U	0.45 U	0.45 U
Bis(2-chloroethyl) Ether	8270C ug/L	0.43 U	0.44 U	0.43 U	0.47 U	0.43 U	0.43 U	0.43 U
Bis(2-chloroisopropyl) Ether	8270C ug/L	0.57 U	0.59 U	0.57 U	0.62 U	0.57 U	0.57 U	0.57 U
Bis(2-ethylhexyl) Phthalate	8270C ug/L	1.1 U	1.2 U	1.1 U	1.2 U	1.1 U	1.1 U	11
Butyl Benzyl Phthalate	8270C ug/L	0.56 U	0.58 U	0.56 U	0.61 U	0.56 U	0.56 U	0.7 J
Chlorobenzilate	8270C ug/L	5.9 U	6.1 U	5.9 U	6.5 U	5.9 U	5.9 U	5.9 U
Chrysene	8270C ug/L	0.51 U	0.53 U	0.51 U	0.56 U	0.51 U	0.51 U	0.51 U
Diallate	8270C ug/L	5 U	5.2 U	5 U	5.5 U	5 U	5 U	5 U
Dibenz(a,h)anthracene	8270C ug/L	0.56 U	0.58 U	0.56 U	0.61 U	0.56 U	0.56 U	0.56 U
Dibenzofuran	8270C ug/L	0.44 U	0.45 U	0.44 U	0.48 U	0.44 U	0.44 U	0.44 U
Diethyl Phthalate	8270C ug/L	0.9 U	0.92 U	0.9 U	0.98 U	0.9 U	0.9 U	4 J
Dimethoate	8270C ug/L	4.1 U	4.2 U	4.1 U	4.5 U	4.1 U	4.1 U	4.1 U
Dimethyl Phthalate	8270C ug/L	0.42 U	0.43 U	0.42 U	0.46 U	0.42 U	0.42 U	0.42 U
Di-n-butyl Phthalate	8270C ug/L	0.91 U	0.93 U	0.91 U	0.99 U	0.91 U	0.91 U	0.91 U
Di-n-octyl Phthalate	8270C ug/L	0.68 U	0.7 U	0.68 U	0.74 U	0.68 U	0.68 U	0.68 U
Dinoseb	8270C ug/L	1.2 U	1.3 U	1.2 U	1.4 U	1.2 U	1.2 U	1.2 U
Disulfoton	8270C ug/L	5 U	5.2 U	5 U	5.5 U	5 U	5 U	5 U
Ethyl Methanesulfonate	8270C ug/L	0.83 U	0.85 U	0.83 U	0.91 U	0.83 U	0.83 U	0.83 U
Famphur	8270C ug/L	6.3 U	6.5 U	6.3 U	6.9 U	6.3 U	6.3 U	6.3 U
Fluoranthene	8270C ug/L	0.26 U	0.27 U	0.26 U	0.29 U	0.26 U	0.26 U	0.26 U
Fluorene	8270C ug/L	0.36 U	0.37 U	0.36 U	0.4 U	0.36 U	0.36 U	0.36 U
Hexachlorobenzene	8270C ug/L	0.33 U	0.34 U	0.33 U	0.36 U	0.33 U	0.33 U	0.33 U
Hexachlorobutadiene	8270C ug/L	0.44 U	0.45 U	0.44 U	0.48 U	0.44 U	0.44 U	0.44 U
Hexachlorocyclopentadiene	8270C ug/L	0.34 U	0.35 U	0.34 U	0.37 U	0.34 U	0.34 U	0.34 U
Hexachloroethane	8270C ug/L	0.52 U	0.54 U	0.52 U	0.57 U	0.52 U	0.52 U	0.52 U
Hexachlorophene	8270C ug/L	100 U	110 U	100 U	110 U	100 U	100 U	100 U
Hexachloropropene	8270C ug/L	1.3 U	1.4 U	1.3 U	1.5 U	1.3 U	1.3 U	1.3 U
Indeno(1,2,3-cd)pyrene	8270C ug/L	0.53 U	0.55 U	0.53 U	0.58 U	0.53 U	0.53 U	0.53 U
Isodrin	8270C ug/L	5.6 U	5.8 U	5.6 U	6.1 U	5.6 U	5.6 U	5.6 U
Isophorone	8270C ug/L	0.64 U	0.66 U	0.64 U	0.7 U	0.64 U	0.64 U	0.64 U
Isosafrole	8270C ug/L	1.4 U	1.5 U	1.4 U	1.6 U	1.4 U	1.4 U	1.4 U
Kepone	8270C ug/L	23 U	24 U	23 U	26 U	23 U	23 U	23 U

Table B3 - Validated results of surface water sample analyses (continued)

Station		SD-01/SW-01	SD-03/SW-02	SD-05/SW-03	SD-06/SW-04	SD-08/SW-05	SD-08/SW-05	SD-10/SW-06
Sample		SW6001	SW6002	SW6003	SW6004	SW6005	SW6007	SW6006
Date		10/14/04	10/18/04	10/18/04	10/18/04	10/19/04	10/19/04	10/19/04
Analyte	Method Units						Field dup	
Methapyrilene	8270C ug/L	3.6 U	3.7 U	3.6 U	4 U	3.6 U	3.6 U	3.6 U
Methyl Methanesulfonate	8270C ug/L	0.59 U	0.61 U	0.59 U	0.65 U	0.59 U	0.59 U	0.59 U
Methyl Parathion	8270C ug/L	6 U	6.2 U	6 U	6.6 U	6 U	6 U	6 U
Naphthalene	8270C ug/L	0.41 U	0.42 U	0.41 U	0.45 U	0.41 U	0.41 U	0.41 U
Nitrobenzene	8270C ug/L	0.58 U	0.6 U	0.58 U	0.64 U	0.58 U	0.58 U	0.58 U
N-Nitrosodiethylamine	8270C ug/L	0.95 U	0.97 U	0.95 U	1.1 U	0.95 U	0.95 U	0.95 U
N-Nitrosodimethylamine	8270C ug/L	0.5 U	0.52 U	0.5 U	0.55 U	0.5 U	0.5 U	0.5 U
N-Nitrosodi-n-butylamine	8270C ug/L	1.6 U	1.7 U	1.6 U	1.8 U	1.6 U	1.6 U	1.6 U
N-Nitrosodi-n-propylamine	8270C ug/L	0.51 U	0.53 U	0.51 U	0.56 U	0.51 U	0.51 U	0.51 U
N-Nitrosodiphenylamine	8270C ug/L	0.34 U	0.35 U	0.34 U	0.37 U	0.34 U	0.34 U	0.34 U
N-Nitrosomethylethylamine	8270C ug/L	0.59 U	0.61 U	0.59 U	0.65 U	0.59 U	0.59 U	0.59 U
N-Nitrosomorpholine	8270C ug/L	0.82 U	0.84 U	0.82 U	0.9 U	0.82 U	0.82 U	0.82 U
N-Nitrosopiperidine	8270C ug/L	1.1 U	1.2 U	1.1 U	1.2 U	1.1 U	1.1 U	1.1 U
N-Nitrosopyrrolidine	8270C ug/L	0.79 U	0.81 U	0.79 U	0.86 U	0.79 U	0.79 U	0.79 U
O,O,O-Triethyl Phosphorothioate	8270C ug/L	4.9 U	5 U	4.9 U	5.4 U	4.9 U	4.9 U	4.9 U
o-Toluidine	8270C ug/L	0.72 U	0.74 U	0.72 U	0.79 U	0.72 U	0.72 U	0.72 U
p-Dimethylaminoazobenzene	8270C ug/L	1.7 U	1.8 U	1.7 U	1.9 U	1.7 U	1.7 U	1.7 U
Parathion	8270C ug/L	5.4 U	5.6 U	5.4 U	5.9 U	5.4 U	5.4 U	5.4 U
Pentachlorobenzene	8270C ug/L	1.5 U	1.6 U	1.5 U	1.7 U	1.5 U	1.5 U	1.5 U
Pentachloroethane	8270C ug/L	5.8 U	6 U	5.8 U	6.4 U	5.8 U	5.8 U	5.8 U
Pentachloronitrobenzene (PCNB)	8270C ug/L	1.5 U	1.6 U	1.5 U	1.7 U	1.5 U	1.5 U	1.5 U
Pentachlorophenol (PCP)	8270C ug/L	0.39 U	0.4 U	0.39 U	0.43 U	0.39 U	0.39 U	0.39 U
Phenacetin	8270C ug/L	1.2 U	1.3 U	1.2 U	1.4 U	1.2 U	1.2 U	1.2 U
Phenanthrene	8270C ug/L	0.26 U	0.27 U	0.26 U	0.29 U	0.26 U	0.26 U	0.26 U
Phenol	8270C ug/L	1.7 U	1.8 U	1.7 U	1.9 U	1.7 U	1.7 U	12
Phorate	8270C ug/L	4.6 U	4.7 U	4.6 U	5 U	4.6 U	4.6 U	4.6 U
Pronamide	8270C ug/L	19 U	20 U	19 U	21 U	19 U	19 U	19 U
Pyrene	8270C ug/L	0.43 U	0.44 U	0.43 U	0.47 U	0.43 U	0.43 U	0.43 U
Pyridine	8270C ug/L	2 U	2.1 U	2 U	2.2 U	2 U	2 U	2 U
Safrole	8270C ug/L	1.4 U	1.5 U	1.4 U	1.6 U	1.4 U	1.4 U	1.4 U
Sulfotep	8270C ug/L	6.4 U	6.6 U	6.4 U	7 U	6.4 U	6.4 U	6.4 U
Thionazin	8270C ug/L	5.5 U	5.7 U	5.5 U	6 U	5.5 U	5.5 U	5.5 U
1,2-Dichlorobenzene	8260B ug/L	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
1,3-Dichlorobenzene	8260B ug/L	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U
1,4-Dichlorobenzene	8260B ug/L	0.085 U	0.085 U	0.085 U	0.085 U	0.085 U	0.085 U	5.4
1,1,1,2-Tetrachloroethane	8260B ug/L	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U

Table B3 - Validated results of surface water sample analyses (continued)

Station		SD-01/SW-01	SD-03/SW-02	SD-05/SW-03	SD-06/SW-04	SD-08/SW-05	SD-08/SW-05	SD-10/SW-06
Sample		SW6001	SW6002	SW6003	SW6004	SW6005	SW6007	SW6006
Date		10/14/04	10/18/04	10/18/04	10/18/04	10/19/04	10/19/04	10/19/04
Analyte	Method Units	Field dup						
1,1,1-Trichloroethane (TCA)	8260B ug/L	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U
1,1,2,2-Tetrachloroethane	8260B ug/L	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
1,1,2-Trichloroethane	8260B ug/L	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U
1,1-Dichloroethane (1,1-DCA)	8260B ug/L	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U	0.08 U
1,1-Dichloroethene (1,1-DCE)	8260B ug/L	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
1,2,3-Trichloropropane	8260B ug/L	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U
1,2-Dibromo-3-chloropropane (DBCP)	8260B ug/L	0.85 U	0.85 U	0.85 U	0.85 U	0.85 U	0.85 U	0.85 U
1,2-Dibromoethane (EDB)	8260B ug/L	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
1,2-Dichloroethane (EDC)	8260B ug/L	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U
1,2-Dichloropropane	8260B ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
1,4-Dioxane	8260B ug/L	52 U	52 UJ	52 UJ	52 UJ	52 U	52 U	52 U
2-Butanone (MEK)	8260B ug/L	0.97 U	0.97 U	0.97 U	0.97 U	0.97 U	0.97 U	5.4 J
2-Chloro-1,3-butadiene (Chloroprene)	8260B ug/L	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U
2-Hexanone	8260B ug/L	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U	1.4 U
2-Methyl-1-propanol (Isobutyl Alcohol)	8260B ug/L	23 U	23 UJ	23 UJ	23 UJ	23 U	23 U	23 U
3-Chloro-1-propene (Allyl Chloride)	8260B ug/L	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U
4-Methyl-2-pentanone (MIBK)	8260B ug/L	0.94 U	0.94 U	0.94 U	0.94 U	0.94 U	0.94 U	0.94 U
Acetone	8260B ug/L	4.2 J	6.2 J	8.2 J	1.9 UJ	50 U	50 U	110
Acetonitrile	8260B ug/L	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U	10 U
Acrolein	8260B ug/L	9.6 U	9.6 UJ	9.6 UJ	9.6 UJ	9.6 U	9.6 U	9.6 U
Acrylonitrile	8260B ug/L	6.7 U	6.7 UJ	6.7 UJ	6.7 UJ	6.7 U	6.7 U	6.7 U
Benzene	8260B ug/L	0.088 U	0.088 U	0.088 U	0.088 U	0.088 U	0.088 U	0.088 U
Bromodichloromethane	8260B ug/L	0.099 U	0.099 U	0.099 U	0.099 U	0.099 U	0.099 U	0.099 U
Bromoform	8260B ug/L	0.28 U	0.28 U	0.28 U	0.28 U	0.28 U	0.28 U	0.28 U
Bromomethane	8260B ug/L	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
Carbon Disulfide	8260B ug/L	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U
Carbon Tetrachloride	8260B ug/L	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U
Chlorobenzene	8260B ug/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Chloroethane	8260B ug/L	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U
Chloroform	8260B ug/L	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	3.1
Chloromethane	8260B ug/L	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U
cis-1,3-Dichloropropene	8260B ug/L	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U	0.14 U
Dibromochloromethane	8260B ug/L	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
Dibromomethane	8260B ug/L	0.22 U	0.22 U	0.22 U	0.22 U	0.22 U	0.22 U	0.22 U
Dichlorodifluoromethane (CFC 12)	8260B ug/L	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
Dichloromethane (Methylene Chloride)	8260B ug/L	0.29 U	0.29 U	0.29 U	0.29 U	0.29 U	0.29 U	0.58 J

Table B3 - Validated results of surface water sample analyses (continued)

Station		SD-01/SW-01	SD-03/SW-02	SD-05/SW-03	SD-06/SW-04	SD-08/SW-05	SD-08/SW-05	SD-10/SW-06
Sample		SW6001	SW6002	SW6003	SW6004	SW6005	SW6007	SW6006
Date		10/14/04	10/18/04	10/18/04	10/18/04	10/19/04	10/19/04	10/19/04
Analyte	Method Units						Field dup	
Ethyl Methacrylate	8260B ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	8260B ug/L	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
Iodomethane (Methyl Iodide)	8260B ug/L	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U
m,p-Xylenes	8260B ug/L	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U
Methacrylonitrile	8260B ug/L	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U
Methyl Methacrylate	8260B ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U
o-Xylene	8260B ug/L	0.083 U	0.083 U	0.083 U	0.083 U	0.083 U	0.083 U	0.083 U
Propionitrile	8260B ug/L	7.6 U	7.6 UJ	7.6 UJ	7.6 UJ	7.6 U	7.6 U	7.6 U
Tetrachloroethene (PCE)	8260B ug/L	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
Styrene	8260B ug/L	0.062 U	0.062 U	0.062 U	0.062 U	0.062 U	0.062 U	0.062 U
Toluene	8260B ug/L	1 U	0.13 U	0.15 J	1 U	0.42 J	0.35 J	3.8
trans-1,2-Dichloroethene	8260B ug/L	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U
trans-1,3-Dichloropropene	8260B ug/L	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
trans-1,4-Dichloro-2-butene	8260B ug/L	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U
Trichloroethene (TCE)	8260B ug/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Trichlorofluoromethane (CFC 11)	8260B ug/L	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U
Vinyl Acetate	8260B ug/L	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U
Vinyl Chloride	8260B ug/L	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
Azinphos-methyl (Guthion)	8141A ug/L	0.027 U	0.029 U	0.029 U	0.029 U	0.029 U	0.029 U	0.029 R
Bolstar (Sulprofos)	8141A ug/L	0.027 U	0.029 U	0.029 U	0.029 U	0.029 U	0.029 U	0.029 R
Chlorpyrifos	8141A ug/L	0.033 U	0.035 U	0.035 U	0.035 U	0.035 U	0.035 U	0.035 R
Coumaphos	8141A ug/L	0.032 U	0.034 U	0.034 U	0.034 U	0.034 U	0.034 U	0.034 R
Demeton-O,S	8141A ug/L	0.047 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 R
Diazinon	8141A ug/L	0.034 U	0.036 U	0.036 U	0.036 U	0.036 U	0.036 U	0.036 R
Dichlorvos	8141A ug/L	0.082 U	0.087 U	0.087 U	0.087 U	0.087 U	0.087 U	0.087 R
Dimethoate	8141A ug/L	0.031 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 R
Disulfoton	8141A ug/L	0.029 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 R
EPN	8141A ug/L	0.032 U	0.034 U	0.034 U	0.034 U	0.034 U	0.034 U	0.034 R
Ethoprop (Prophos)	8141A ug/L	0.039 U	0.042 U	0.042 U	0.042 U	0.042 U	0.042 U	0.042 R
Fensulfothion	8141A ug/L	0.041 U	0.044 U	0.044 U	0.044 U	0.044 U	0.044 U	0.044 R
Fenthion	8141A ug/L	0.031 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 R
Malathion	8141A ug/L	0.052 U	0.055 U	0.055 U	0.055 U	0.055 U	0.055 U	0.055 R
Merphos	8141A ug/L	0.042 U	0.045 U	0.045 U	0.045 U	0.045 U	0.045 U	0.045 R
Methyl Parathion	8141A ug/L	0.032 U	0.034 U	0.034 U	0.034 U	0.034 U	0.034 U	0.034 R
Mevinphos	8141A ug/L	0.05 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 R
Parathion	8141A ug/L	0.031 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 R

Table B3 - Validated results of surface water sample analyses (continued)

Station		SD-01/SW-01	SD-03/SW-02	SD-05/SW-03	SD-06/SW-04	SD-08/SW-05	SD-08/SW-05	SD-10/SW-06
Sample		SW6001	SW6002	SW6003	SW6004	SW6005	SW6007	SW6006
Date		10/14/04	10/18/04	10/18/04	10/18/04	10/19/04	10/19/04	10/19/04
Analyte	Method Units						Field dup	
Phorate	8141A ug/L	0.025 U	0.027 U	0.027 U	0.027 U	0.027 U	0.027 U	0.027 R
Ronnel	8141A ug/L	0.047 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 R
Stirophos (Tetrachlorovinphos)	8141A ug/L	0.023 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 R
Sulfotep	8141A ug/L	0.046 U	0.049 U	0.049 U	0.049 U	0.049 U	0.049 U	0.049 R
Tokuthion (Prothiofos)	8141A ug/L	0.023 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 R
Trichloronate	8141A ug/L	0.025 U	0.027 U	0.027 U	0.027 U	0.027 U	0.027 U	0.027 R
2,4,5-T	8151A ug/L	0.088 U	0.088 U	0.088 U	0.088 U	0.092 U	0.092 U	0.097 U
2,4,5-TP (Silvex)	8151A ug/L	0.06 U	0.06 U	0.06 U	0.06 U	0.062 U	0.066 J	0.066 U
2,4-D	8151A ug/L	0.18 U	0.18 U	0.18 U	0.18 U	0.19 U	0.19 U	0.2 U
4,4'-DDD	8081A ug/L	0.0079 U	0.0081 U	0.0084 U	0.0082 U	0.0079 U	0.0079 U	0.0079 U
4,4'-DDE	8081A ug/L	0.0084 U	0.0086 U	0.0089 U	0.0087 U	0.0084 U	0.0084 U	0.0084 U
4,4'-DDT	8081A ug/L	0.013 U	0.014 UJ	0.014 UJ	0.014 UJ	0.013 U	0.013 U	0.013 U
Aldrin	8081A ug/L	0.0068 U	0.007 U	0.0072 U	0.0071 U	0.0068 U	0.0068 U	0.0068 UJ
alpha-BHC	8081A ug/L	0.0079 U	0.0081 U	0.0084 U	0.0082 U	0.0079 U	0.0079 U	0.0079 U
alpha-Chlordane	8081A ug/L	0.0066 U	0.0068 U	0.007 U	0.0069 U	0.0066 U	0.0066 U	0.0066 U
beta-BHC	8081A ug/L	0.0085 U	0.0087 U	0.009 U	0.0088 U	0.0085 U	0.0085 U	0.0085 U
delta-BHC	8081A ug/L	0.011 U	0.012 U	0.012 U	0.012 U	0.011 U	0.011 U	0.011 U
Dieldrin	8081A ug/L	0.0073 U	0.0075 U	0.0077 U	0.0076 U	0.0073 U	0.0073 U	0.0073 U
Endosulfan I	8081A ug/L	0.0089 U	0.0091 U	0.0094 U	0.0092 U	0.0089 U	0.0089 U	0.0089 U
Endosulfan II	8081A ug/L	0.0064 U	0.0066 U	0.0068 U	0.0066 U	0.0064 U	0.0064 U	0.0064 U
Endosulfan Sulfate	8081A ug/L	0.0092 U	0.0094 U	0.0097 U	0.0095 U	0.0092 U	0.0092 U	0.0092 U
Endrin	8081A ug/L	0.009 U	0.0092 U	0.0095 U	0.0093 U	0.009 U	0.009 U	0.009 U
Endrin Aldehyde	8081A ug/L	0.0085 U	0.0087 U	0.009 U	0.0088 U	0.0085 U	0.0085 U	0.0085 U
Endrin Ketone	8081A ug/L	0.0053 U	0.0055 U	0.0056 U	0.0055 U	0.0053 U	0.0053 U	0.0053 U
gamma-BHC (Lindane)	8081A ug/L	0.0082 U	0.0084 U	0.0087 U	0.0085 U	0.0082 U	0.0082 U	0.0082 U
gamma-Chlordane	8081A ug/L	0.0075 U	0.0077 U	0.0079 U	0.0078 U	0.0075 U	0.0075 U	0.0075 U
Heptachlor	8081A ug/L	0.0096 U	0.0098 U	0.011 U	0.0099 U	0.0096 U	0.0096 U	0.0096 U
Heptachlor Epoxide	8081A ug/L	0.0079 U	0.0081 U	0.0084 U	0.0082 U	0.0079 U	0.0079 U	0.0079 U
Methoxychlor	8081A ug/L	0.011 U	0.012 U	0.012 U	0.012 U	0.011 U	0.011 U	0.011 U
Toxaphene	8081A ug/L	0.5 U	0.52 U	0.53 U	0.52 U	0.5 U	0.5 U	0.5 U
Aroclor 1016	8082A ug/L	0.13 U	0.14 U	0.14 U	0.14 U	0.13 U	0.13 U	0.13 UJ
Aroclor 1221	8082A ug/L	0.33 U	0.34 U	0.35 U	0.35 U	0.33 U	0.33 U	0.33 UJ
Aroclor 1232	8082A ug/L	0.19 U	0.2 U	0.2 U	0.2 U	0.19 U	0.19 U	0.19 UJ
Aroclor 1242	8082A ug/L	0.12 U	0.13 U	0.13 U	0.13 U	0.12 U	0.12 U	0.12 UJ
Aroclor 1248	8082A ug/L	0.12 U	0.13 U	0.13 U	0.13 U	0.12 U	0.12 U	0.12 UJ
Aroclor 1254	8082A ug/L	0.14 U	0.15 U	0.15 U	0.15 U	0.14 U	0.14 U	0.14 UJ

Table B3 - Validated results of surface water sample analyses (continued)

Station	SD-01/SW-01	SD-03/SW-02	SD-05/SW-03	SD-06/SW-04	SD-08/SW-05	SD-08/SW-05	SD-10/SW-06
Sample	SW6001	SW6002	SW6003	SW6004	SW6005	SW6007	SW6006
Date	10/14/04	10/18/04	10/18/04	10/18/04	10/19/04	10/19/04	10/19/04
Analyte	Method Units					Field dup	
Aroclor 1260	8082A ug/L	0.11 U	0.12 U	0.12 U	0.12 U	0.11 U	0.11 UJ

Notes:

U - not detected at detection limit shown

UJ - estimated detection limit

J - estimated

B (metals) - estimated